

Training Manual

SpectraPoint™ SP2200 System
Basics

Issue 1

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Part No. 3215397



SpectraPoint™ LMDS

Local Multipoint Distribution Services

Preface

To the student

This manual is written as a basic text for understanding the SP2200 system. It is intended for individuals who will install, operate, and maintain the SpectraPoint™ SP2200 Base Station.

Conventions

The following textual convention is used in this manual:

Note: This is used for clarification of any topic being covered. Note is bolded, followed by a colon, and the note text is *italicized*.

Attention: This is used when something that affects proper operation needs to be stressed. Attention is bolded, followed by a colon, and the attention text is *italicized*.

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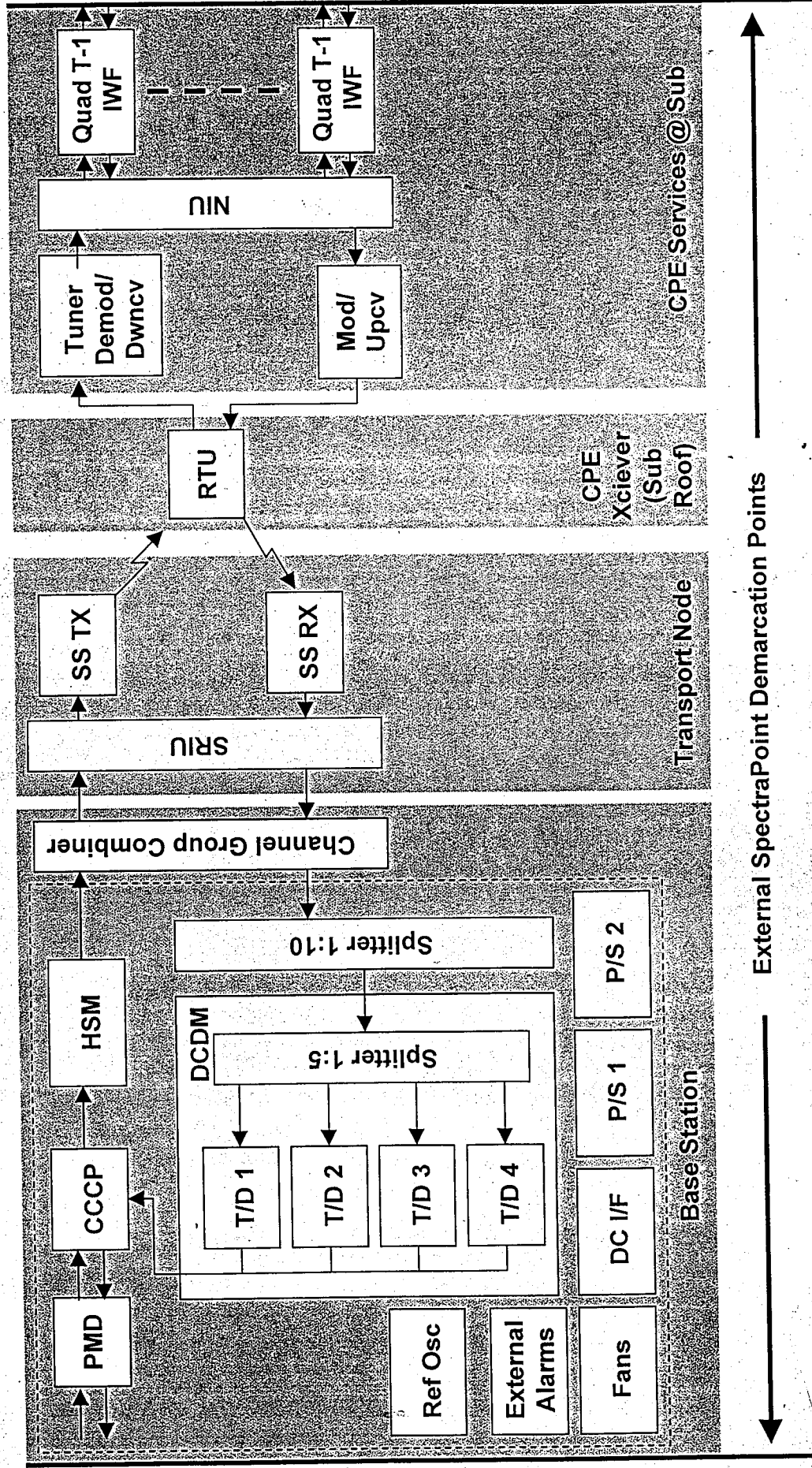
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Training Manual

SP2200 System Basics

Contents

Section	Description
1	SP2200 Basics Class Introduction
2	SP2200 System Overview
3	Base Description
4	Node Description
5	Customer Premises Equipment (CPE) Overview
6	Glossary of Terms and Acronyms





Class Introduction

Overview

This course is designed to give the student an introduction to the SpectraPoint SP2200 LMDS System.

Course Objectives

Given the necessary documentation and equipment, upon completion of this course, the student will be able to recognize:

- Subsystems of the SP2200 system
 - Base Station
 - Customer Premises Equipment (CPE)
 - System Management Software
- Key Features and functions of the SP2200 System

Slide 1-1

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SP2200 Basics Class Introduction

This training manual provides a general description of the **SpectraPoint™** SP2200 system equipment needed to provide Local Multipoint Distribution Services (LMDS) and includes a review of LMDS fundamentals. See slide 1-1 for course objectives.

The SP2200 subsystems include the following:

Base

The Base interfaces to a public or private network. It encodes inbound ATM Cells, converts these signals to an Intermediate Frequency (IF), and transports them to the Node. It includes hardware and software required for operating, controlling, and monitoring the SpectraPoint™ SP2200 LMDS system. The Base also receives signals on the return path from the Node equipment at IF, downconverts and decodes the ATM cells before they are transmitted back to the ATM source

Node

The Node receives IF signals from the Base, perform upconversion to 28 GHz, and transmits the outbound traffic to

SP2200 General Description Class Introduction

Node, continued

the Customer Premises Equipment (CPE). It also receives the in-bound 28 GHz signals from the CPE and downconverts these signals to IF and transports them to the Base. The Node covers up to a 5 kilometer radius, is divided into 90° sectors, and may contain up to four sectors. Each sector includes a mounting frame with transmitters and receivers, and a Sector Radio Interface Unit (SRIU) to distribute the payload transmissions, control signals, and -48 V DC power.

Customer Premises Equipment (CPE)

The CPE includes the Rooftop Unit (RTU) and the Network Interface Unit (NIU).

Rooftop Unit (RTU) - The antenna and associated hardware placed (in open air position) on the roof or other elevated position at the subscriber's location for receiving the LMDS transport.

Network Interface Unit (NIU) - The unit placed inside the subscriber's location providing interface to the subscriber network.

Note: *The subscriber's network access equipment that connects to the NIU may or may not be furnished by the LMDS provider (this includes channel banks, multiplexers, routers, and other data equipment). This equipment is not included in this training course.*



Class Information

- Student Introductions
- Daily Schedule
- Logistics
- Course Topics

Slide 1-3

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Class Information

See slide 1-3 for details.



Class Topics

- SP2200 System Overview
- Base Description
- Node Description
- Customer Premises Equipment Overview

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Class Topics

The class topics are shown in slide 1-4. The training manual is organized in sections to cover each of these topics.



SP2200 System Overview

Upon completion of this section, the student will be able to discuss the following key features of the SP2200 system:

- SP2200 subsystems
 - Base Station
 - Customer Premises Equipment (CPE)
 - System management software
- SP2200 Downstream transport
- SP2200 Upstream transport

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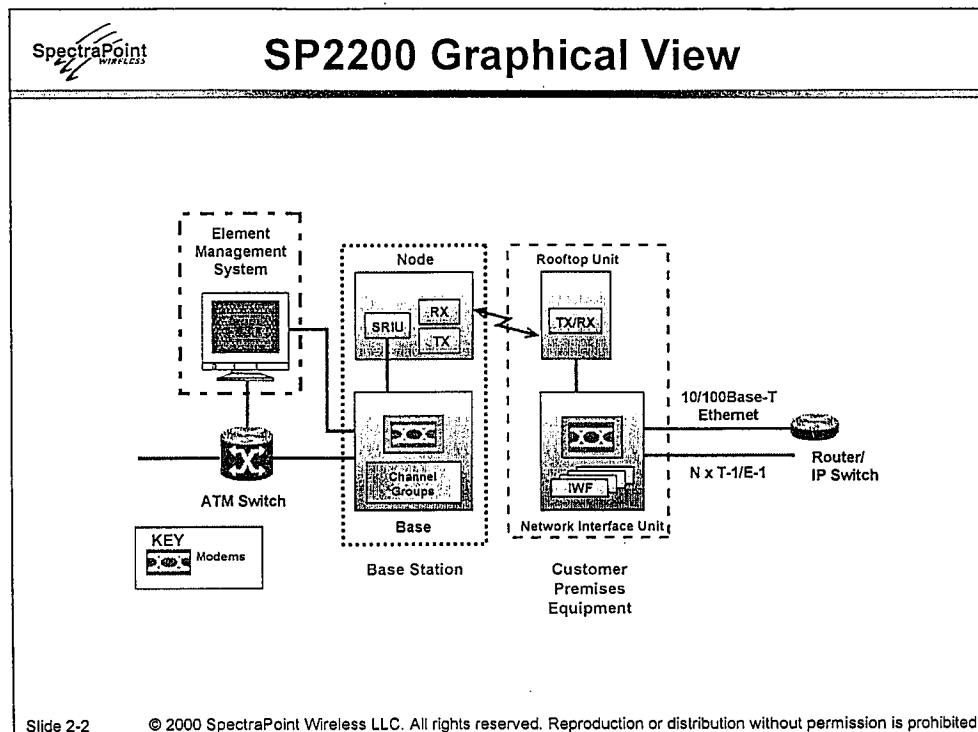
SP2200 System Overview

See slide 2-1 for section objectives.

General

The **SpectraPoint™** SP2200 System is an ATM-based broadband wireless communications product designed to provide wireless communication service at 28 GHz. It delivers telephone and data services to the subscriber "Over the Air" (OTA) from the provider location, rather than using a wired **local loop**.

The SP2200 System is intended to break the last mile bottleneck and extend the reach of a New World Network (NWN) into the customer's premises. A New World Network (NWN) arrives at the time of global realization that the quantity of data traffic over some service provider networks now exceeds or will soon exceed the total of all voice traffic.

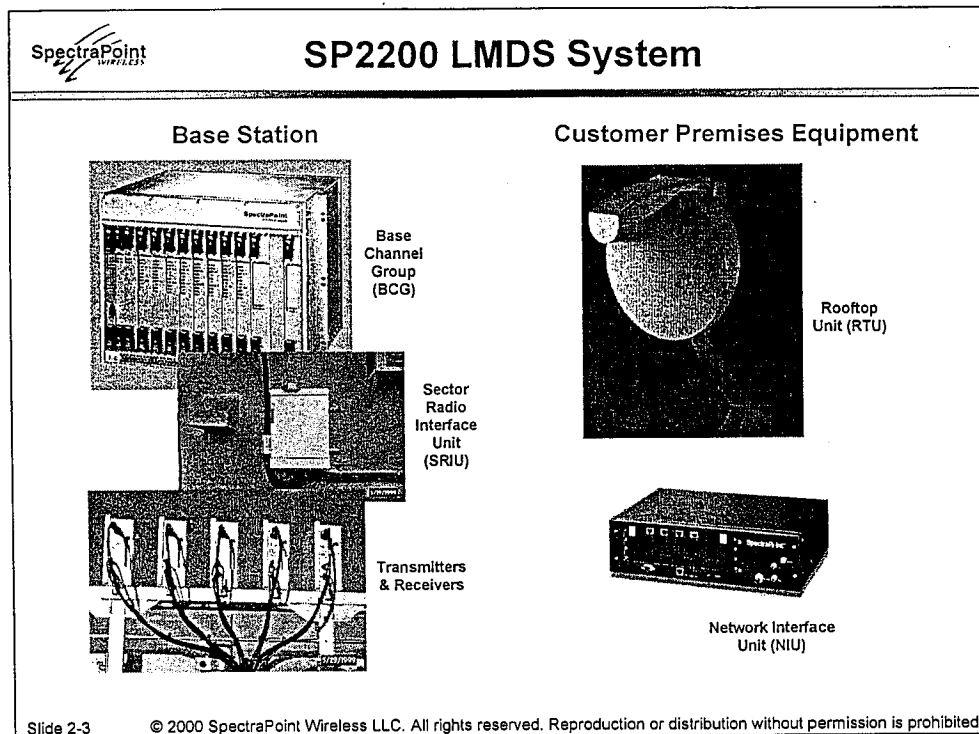


SP2200 Graphical View

The SpectraPoint™ SP2200 LMDS architecture consists of three major subsystems as shown in slide 2-2:

- Base Station
 - Base Channel Groups
 - Node (on the roof)
 - > Sector Radio Interface Unit (SRIU)
 - > Sector Mounting Frame
 - > Transmitters & Receivers
- Customer Premises Equipment (CPE)
 - Rooftop Unit (RTU)
 - Network Interface Unit (NIU)
- Element Management System (EMS)

Each of these subsystems is modular and may be scaled to fit the customer's application.

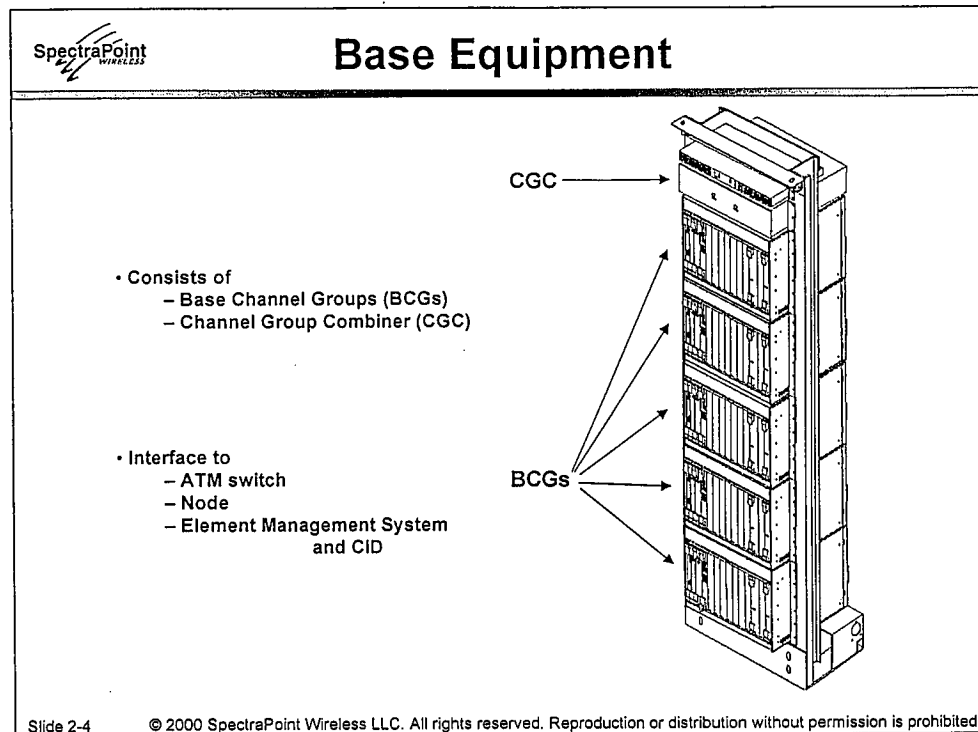


SP2200 LMDS System

Slide 2-3 shows photos of the main components of the SP2200 system.

Key Features

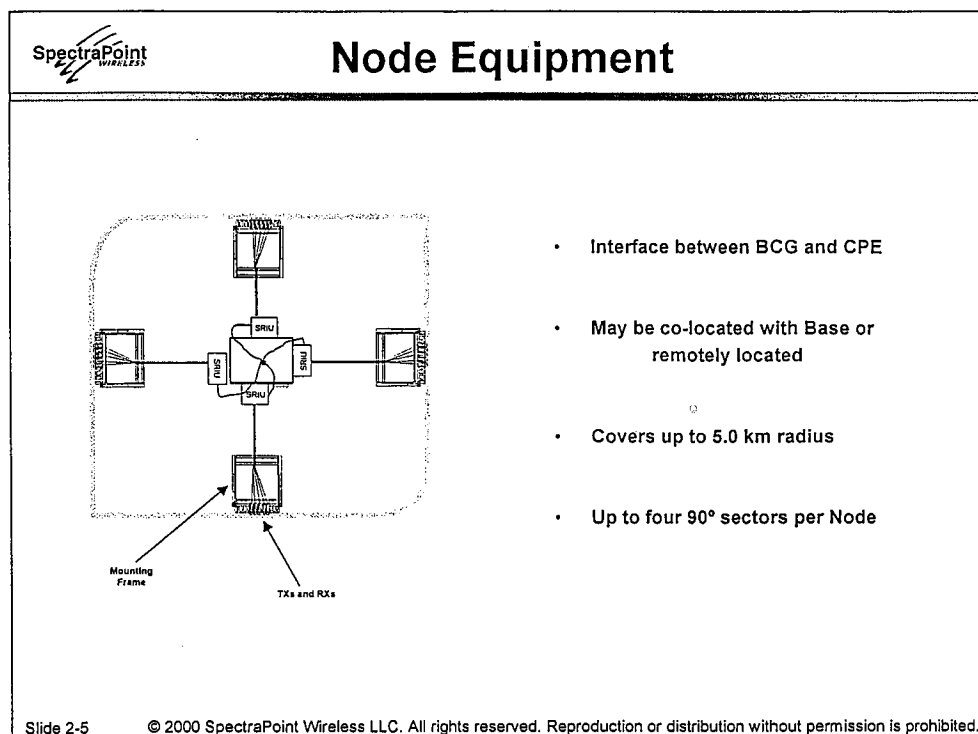
- Point-To-Multipoint Access
- ATM Packet Protocol
- Support for voice and data services
 - AAL-1 for voice (Constant Bit Rate, or CBR)
 - AAL-5 for Frame Relay and Internet (Variable Bit Rate, or VBR)
- NIU provides modular interfaces
- Customer links available include T-1/E-1 CES, N x 64k, and 10Base-T; planned services include Frame Relay access, HSSI, Multifunction (8n) cards, and DS-0 grooming.



Base Equipment

Slide 2-4 shows the Base equipment: the Base Channel Groups (BCGs) and the Channel Group Combiner (CGC).

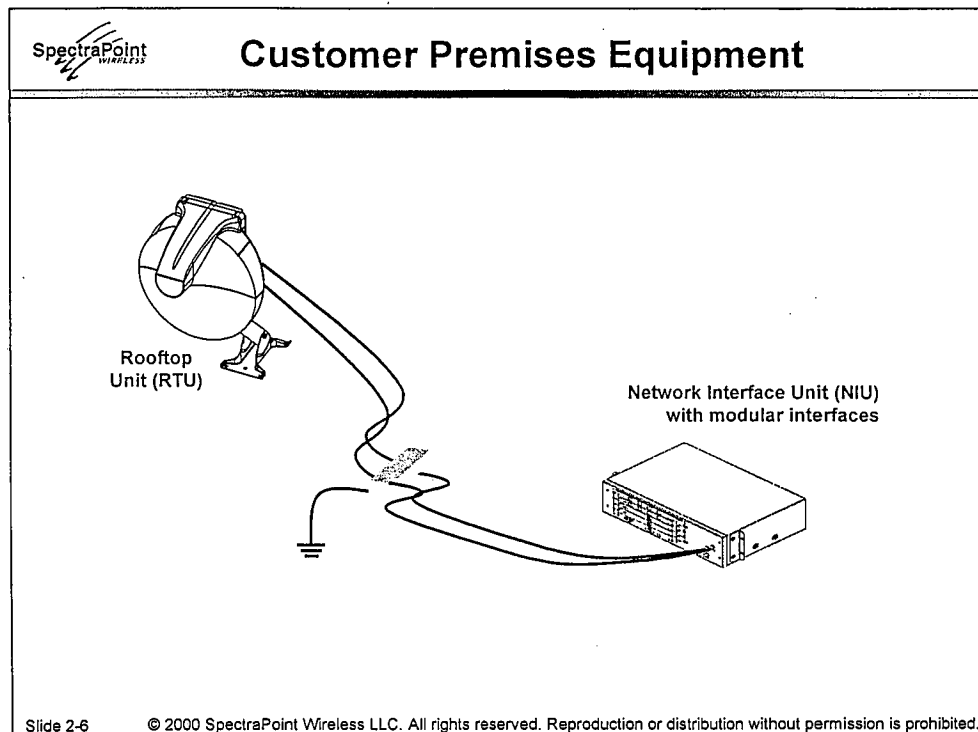
- The Base utilizes multiple Base Channel Groups (BCGs) and a Channel Group Combiner (CGC) per sector.
 - A maximum of 9 active BCGs may be supported per sector, and a total of 36 per Node.
 - The number of BCGs deployed depends on the capacity and coverage requirements of the site.
- The BCG is the "building block" that provides the interface between the ATM switch and the L-band IF signals that are sent to and received from the Sector Radio Interface Unit (SRIU) using the CGC. It also provides the interface to the SpectraPoint™ Element Management System (EMS) and Craft Interface Device (CID).
- Base equipment is described in Section 3.



Node Equipment

The Node equipment is shown in slide 2-5. The Node broadcasts and receives signals between the Base equipment and the CPEs.

- The Node is the interface between BCG and CPE. It receives the L-band IF signals from the Base, converts this to the Ka Band transmission sent to the CPE.
- It may be co-located with Base, or remotely located up to 20 km away using analog fiber.
- A Node can have up to four 90° sectors and may cover up to 5.0 km radius depending on the rain zone.
 - Each sector includes a mounting frame with transmitters and receivers, and a Sector Radio Interface Unit (SRIU).
 - Adjacent sector transmission signals are alternatively polarized vertically or horizontally. This mitigates cross-talk/interference in overlapping sectors and allows frequency reuse.
- Node equipment is described in Section 4.



Customer Premises Equipment

Customer Premises Equipment (CPE) is shown in slide 2-6.

- CPE consists of a Rooftop Unit (RTU) with an antenna and built-in electronics, and a Network Interface Unit (NIU) which connects to the subscriber's network.
 - The RTU receives the Ka Band broadcast from the Node and converts it to L-band IF for the NIU.
 - The NIU converts the L-band IF to T-1 or E-1 for connection to the subscriber's equipment.
- CPE may also include channel banks, routers, or other equipment deployed to meet the subscriber's network requirements. These are deployment-specific and may or may not be supplied by SpectraPoint Wireless.
- Customer Premises Equipment is overviewed in Section 5 and detailed in a separate training course.



SP2200 System Management Software

- Management Software Packages
 - SpectraPoint™ EMS
(Element Management System)
 - SpectraPRO

- Controller Card Embedded Software

Slide 2-7

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SP2200 System Management Software

Two types of management software used to support the SP2200 system are shown in slide 2-7.

Management Software Packages

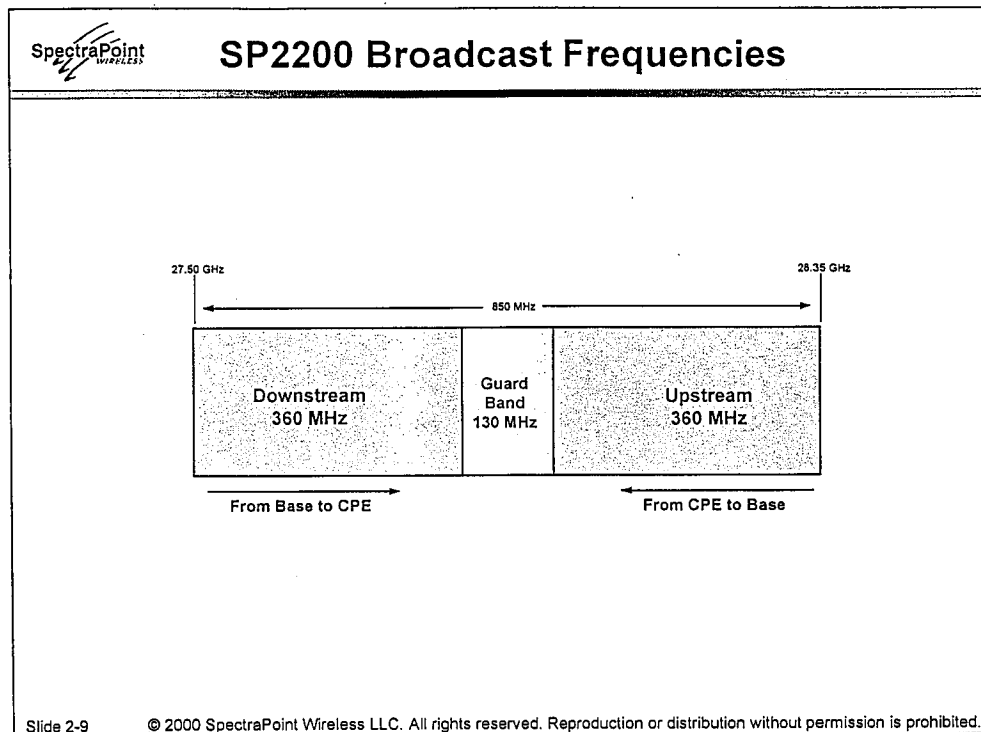
- ***Element Management System (EMS)*** - The EMS provides Element Management, Provisioning, Security Management, Performance management, and Fault Management for the SP2200 system. The EMS software runs on a UNIX platform and provides a customized set of SP2200 windows. It is normally used at a Network Operations Center (NOC).
 - The EMS software is a subset of Bosch's OPEN NSÜ and serves as the SNMP manager for the SP2200 system SNMP agents.
 - OPEN NSÜ is a Network Management System (NMS) that supports the EMS, and the SpectraPoint EMS can run on other NMS. The OPEN NSÜ has the capability of passing information through to that NMS.
 - SP2200 system software may be remotely downloaded using the EMS.

Management Software Packages

Note: *The SpectraPoint EMS and OPEN NSÜ are detailed in a separate training course.*

- **SpectraPRO software running on a Craft Interface Device (CID)**
 - a Personal Computer (PC) running SpectraPRO software is referred to as a Craft Interface Device (CID).
 - SpectraPRO was created to support initial configurations of the SP2200.
 - It can be used for monitoring and troubleshooting at an installed (Base Station or subscriber [CPE]) location.
 - Software may be downloaded using SpectraPRO.
 - SpectraPRO software is covered in the 2200 Provisioning training course.

SpectraPoint™ Embedded Software is used on controller cards in the Base Channel Group (BCG). When the SP2200 is provisioned, this proprietary software is accessed using one of the SpectraPoint™ management software packages just discussed, and the parameters are configured according to the Installation Plan (or Work Order). This software can be upgraded by downloading new revisions, either locally with a CID or remotely using EMS.



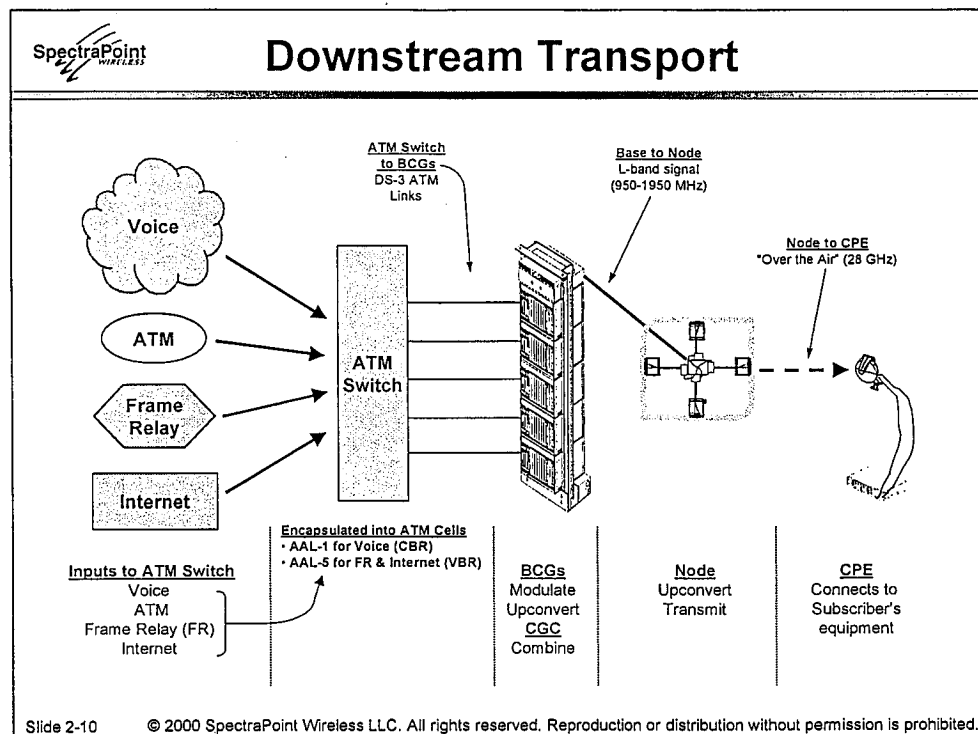
SP2200 Broadcast Frequencies

The SP2200 Node broadcasts the combined IF signals at the appropriate frequency for the host country; as of the date of this manual, the 2200 Node broadcasts at 28 GHz only. An example bandplan for 28 GHz (27.50 – 28.35 GHz) is shown in slide 2-9.

The SP2200 LMDS spectrum per 90° sector is subdivided as shown:

- 360 MHz used for Downstream (Base to CPE)
- 360 MHz used for Upstream (CPE to Base)
- 130 MHz used for guard band (or in-band Point-to-Point radio)

Note: For exact Node and sector specifications, see the *SP2000 Series Node equipment manual*.



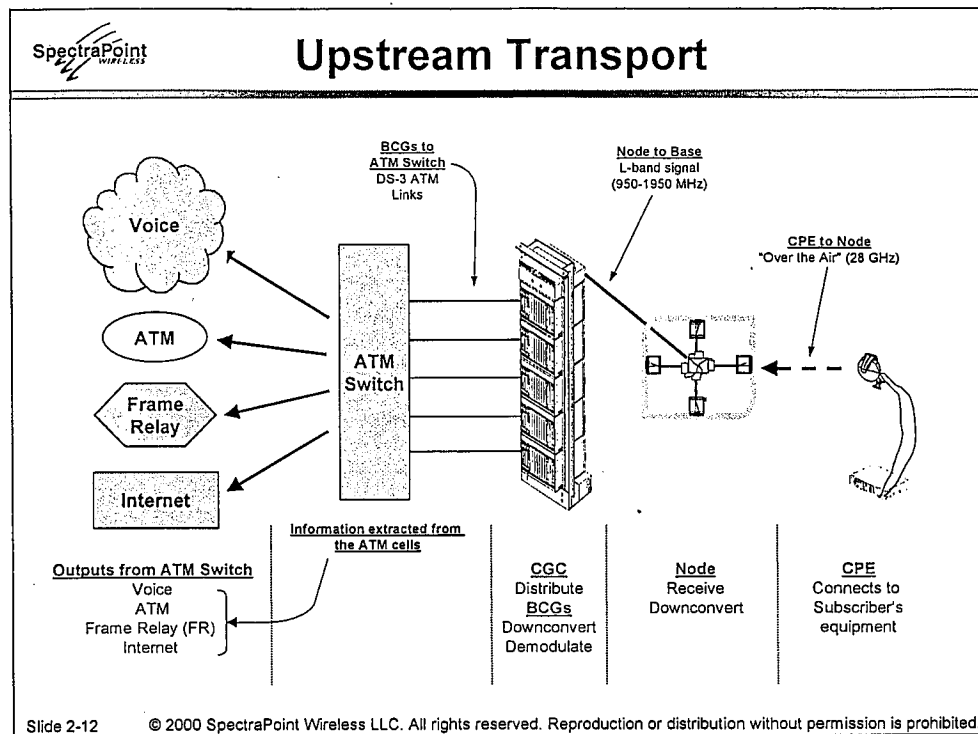
Downstream Transport

Downstream is the transport path of the information flow from the Base to the CPE. The Downstream path is illustrated in slide 2-10.

- Voice from the Public Switched Telephone Network (PSTN), Internet from an Internet Service Provider (ISP), and data from other sources (such as Frame Relay or ATM providers) is input into an ATM switch at the Base location for processing.
 - Voice is encapsulated into ATM cells using AAL-1 format (used for Constant Bit Rate [CBR] services).
 - Frame Relay and Internet services are encapsulated using AAL-5 format (used for Variable Bit Rate [VBR] services).
 - Various types of equipment used to terminate the source services are not shown in the drawing, and will depend on the deployment.
- The encapsulated services are then transported to Base Channel Groups (BCGs) using DS-3 links from the ATM switch.

Downstream Transport, continued

- At the BCG, the Time Division Multiplexed (TDM) ATM cells are modulated and upconverted into L-band IF (Intermediate Frequency, 950 MHz - 1950 MHz), and the BCG IF outputs are combined at the Channel Group Combiner (CGC).
 - System control information is also embedded in the ATM cells and included in the ATM stream.
- This combined signal is transmitted from the BCGs to the Sector Radio Interface Unit (SRIU), and then distributed to the Transmitters.
- The Transmitters upconvert the signals to Ka Band (28 GHz), and send the ATM cells to the CPEs "Over the Air" (OTA).



Upstream Transport

The Upstream transport path shown in slide 2-12 is the reverse of the Downstream process. This is the flow of information from the CPE to the Base.

- The Ka Band (28 GHz) signals (ATM cells) received from the CPEs at the broadband Receiver are downconverted to IF L-band, and transmitted to the Channel Group Combiner (CGC).
- The CGC distributes the combined signals from the Receiver to the BCGs.
- At each BCG, the ATM cells are distributed to a Quad Downconverter/Demodulator (DCDM) card for frequency conversion, demodulation and decoding. Next, the ATM cells are sent to the Channel Controller/Cell Processor (CCCP) card.
- The CCCP card directs the ATM cells to be transported back to the ATM switch over DS-3 links.
- Finally, the ATM switch extracts the services from the ATM cells and transports the traffic to the service provider (Voice, ISP, or other source).



Review Questions

(1) What are the subsystems of the SP2200?

- _____
- _____
- _____

(2) The Base and the Node comprise the subsystem known as the _____.

(3) A Node can have as many as __ sectors.

(4) The _____ distributes the information from the Base to the Transmitters.

(5) Because LMDS is provided "over the air" (OTA), it requires _____ between the Node and the CPE.

Slide 2-13

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Review Questions

See slide 3-13 for end-of-section review questions.



Base Description

Upon completion of this section, the student will be able to discuss the following key features of the SP2200 Base:

- Base Channel Group (BCG)
 - BCG cards
 - Power requirement
 - Interfaces
 - > PMD card, connections
 - > Other external interfaces
- Channel Group Combiner (CGC)
- BCG Deployment

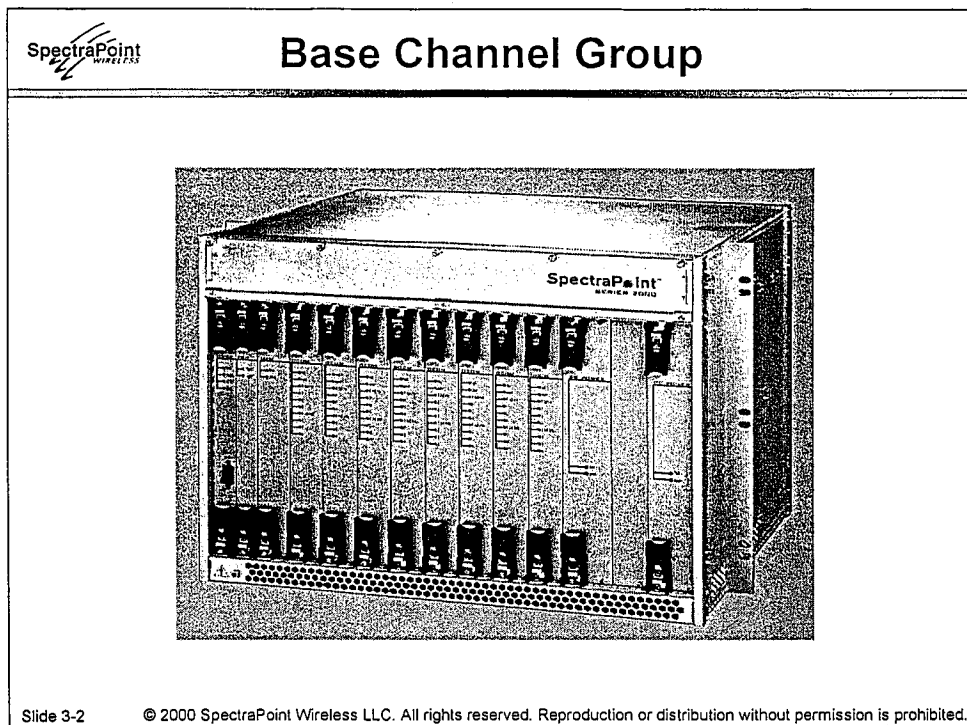
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Base Description

This section provides a description of Base equipment. The Base equipment includes the Base Channel Group and the Channel Group Combiner. See slide 3-1 for section objectives.

General

The Base interfaces to a public or private network. It encodes inbound ATM Cells, converts these signals to an Intermediate Frequency (IF), and transports them to the Node for over-the-air (OTA) transmission at 28 GHz. It includes hardware and software required for operating, controlling, and monitoring the SpectraPoint™ SP2200 LMDS system. The Base also receives signals at IF, downconverts and decodes the information on the return path from the Node equipment.



Base Channel Group

A drawing of a Base Channel Group (BCG) is shown in slide 3-2.

Available Models

- The SP2200 BCG is available with a DS-3c ATM interface and two load-sharing DC Supply cards (-48 V DC). It is only available in a -48 V DC version.
- Up to 9 active BCGs can be supported per 90° sector, and a Node can have up to four sectors.
- Redundancy options are available.

Mounting and Installation

- The BCG is mounted in an 8U (35.6 cm/14 in) vertical rack space in a 48 cm/19 in rack.
- All inputs, as well as output to the Channel Group Combiner (CGC) connect to ports on the rear of the unit.
- All circuit cards are installed into slots from the front of the BCG.

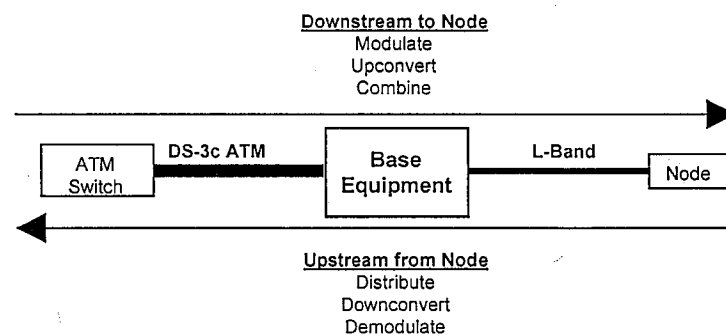
Base Channel Group, continued

Function and Operation

The Base Channel Group (BCG) is the “building block” of the Base, and provides the interface between the ATM switch and the Node.

Transmit

- The BCG modulates and converts ATM cells from the ATM switch (or Add-and-Drop Multiplexer [ADM]) into L-band Intermediate Frequency (IF) signals.
- These signals are combined with Local Oscillator (LO) reference/Pilot Tone in the Channel Group Combiner (CGC) and transmitted using a single coaxial or fiber cable to the Sector Radio Interface Unit (SRIU).

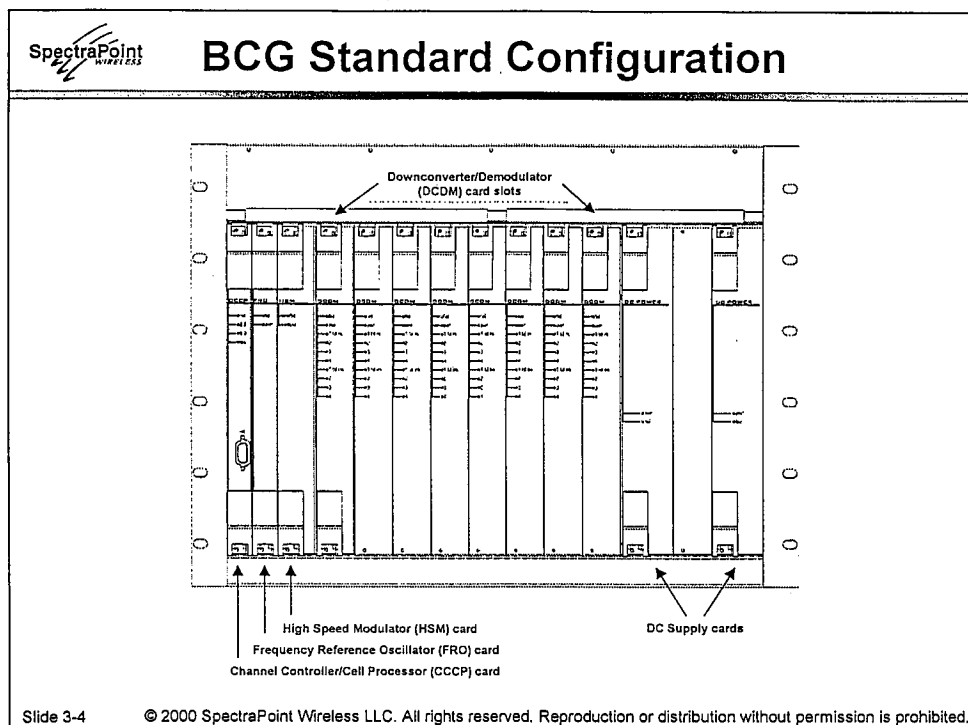


Receive

- A second cable carries the L-band IF returning (RX) from the Node Receiver to the Channel Group Combiner (CGC) through the SRIU. The CGC distributes the channels to the correct BCG.
- The Base Channel Group downconverts and demodulates the ATM cells before passing the signals on to the ATM switch (or ADM).

Base Control

- RS-485 control signals from the Base to the Node are carried on a separate multi-wire cable from the Primary BCG to the SRIU for each sector.
- RS-485 provides Traffic management, Fault Monitoring, and Power Control.

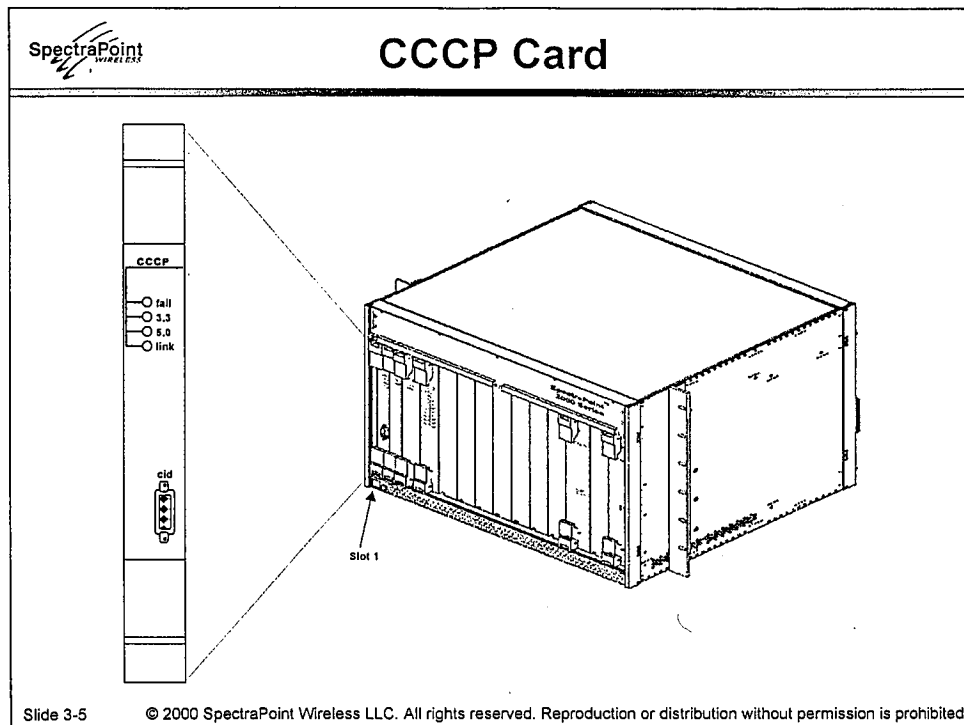


Base Channel Group (BCG) Standard Configuration

Slide 3-4 shows the front view of a Base Channel Group. A BCG supports the following cards:

- **Channel Controller/Cell Processor (CCCP) card**
see pages 3-5 and 3-6
- **Frequency Reference Oscillator (FRO) card**
see pages 3-7 and 3-8
- **High Speed Modulator (HSM) card**
see pages 3-9 and 3-10
- **Downconverter/Demodulator (DCDM) card**
see pages 3-11 and 3-12
- **DC Supply card**
see page 3-13

Interface to the BCG is in the rear of the shelf using a Physical Medium Dependent (PMD) card and two connector panels. This is detailed on pages 3-14 through 3-16.



Channel Controller/Cell Processor (CCCP) Card

The Channel Controller/Cell Processor (CCCP) card controls all shelf functions and all channel functions. A drawing of the CCCP card is shown in slide 3-5.

Functionality

- Primary configuration control for Node equipment
- Processes ATM payload cells downstream and upstream
- Processes ATM OAM cells for Element Management
- Manages the Base radio redundancy for primary channel
- SNMP Agent
- Internal communications
 - Serial bus
 - UTOPIA bus
- External communications
 - Ethernet
 - Network interface
 - RS-485 processing
- Provides Built-In Test (BIT) to isolate failures
 - within Base Channel Group
 - within own circuit card
 - to individual CPEs

ORC
ADMIN
MUST
PROV.

Channel Controller/Cell Processor (CCCP) Card

Functionality, continued

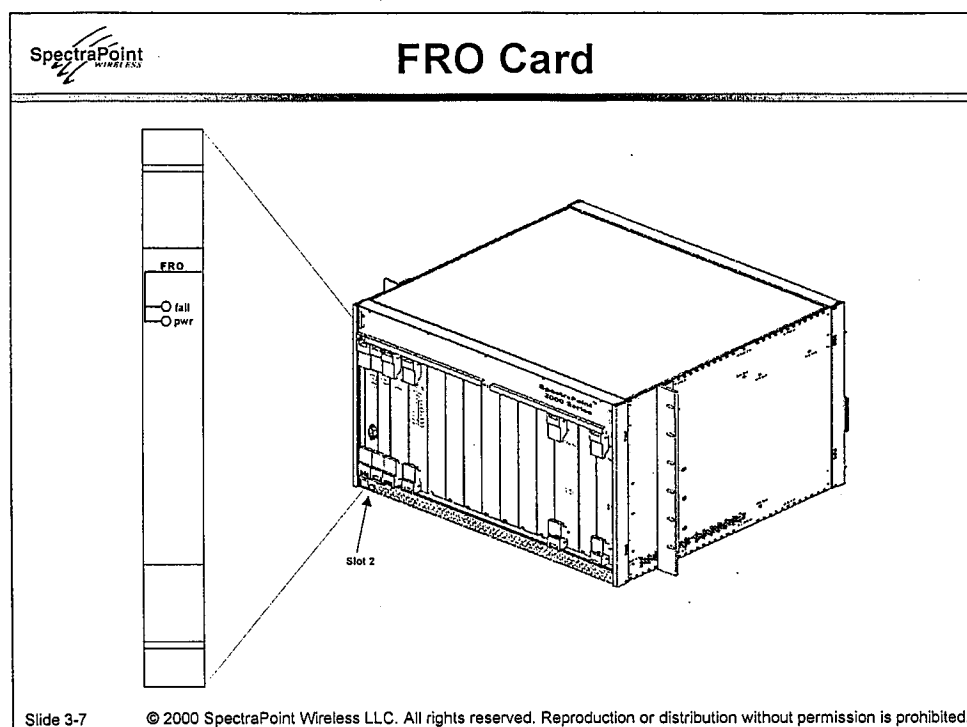
- Microprocessor software is remote downloadable
- 512 kbytes nonvolatile memory
- Controls Frequency Reference Oscillator (FRO) card functions - detects reference availability and can configure source
- Has RS-232 connector on card front for local access

Attention: *This card can be hot swapped. However, it is non-redundant and provides common support for the Base Channel Group. Removal or replacement of this card will affect the entire Base Channel Group.*

Card Status LEDs

The following card status LEDs are displayed on the front of the card:

- *fail* illuminates if a Built-in Test (BIT) fault is detected (red).
- *3.3* illuminates when the DC voltage required by card is present and good (green).
- *5.0* illuminates when the DC voltage required by card is present and good (green).
- *link* illuminates when an Ethernet connection to the BCG is active (green).



Frequency Reference Oscillator (FRO) Card

The Frequency Reference Oscillator (FRO) card provides a 10 MHz reference signal to the Base Channel Group. Slide 3-7 shows a drawing of the FRO card.

Functionality

- Provides a 10-MHz reference for BCG
- With BCG release 1.0, the FRO in each BCG is set to free run (on-board clock).
- Future enhancement will have all BCGs in a sector synchronize to a single clock:
 - Primary BCG source will be free run, secondary choice will be external clock source.
 - All other BCGs in the sector use output from Primary BCG as an external input, alternate choice will be free run.
 - > Software on card determines which source to use.
 - > Will switch to alternate source automatically when preferred source fails.
- Fault isolation using Built-In Test (BIT) feature - detects presence of good incoming signal and good output signal.

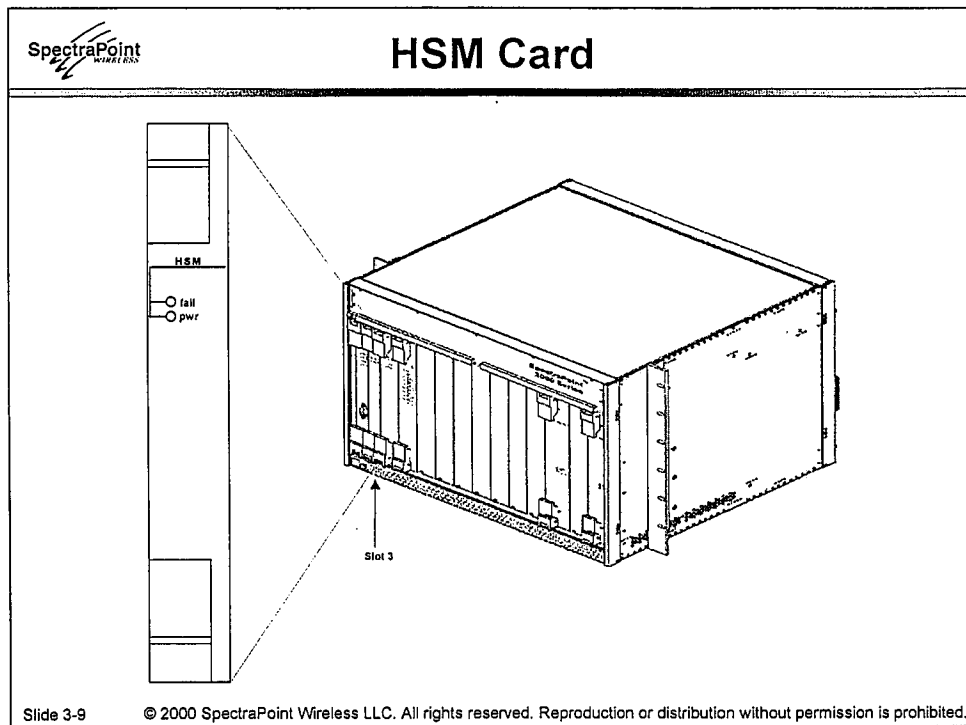
Frequency Reference Oscillator (FRO) Card, continued

Attention: *This card can be hot swapped. However, it is non-redundant and provides common support for the Base Channel Group. Removal or replacement of this card will affect the entire Base Channel Group.*

Card Status LEDs

The following card status LEDs are on the front of the card:

- *fail* illuminates if a Built-in Test (BIT) fault is detected (red).
- *pwr* illuminates when DC voltage required by the card is present and good (green).



High Speed Modulator (HSM) Card

Slide 3-9 shows a drawing of the High Speed Modulator (HSM) card.

Functionality

- Modulates and encodes the downstream signals
 - shapes the modulated waveform
 - controls the carrier power level
 - provides data interface to modulator input
- Provides command and control link with Cell Processor
- Supplies 960 MHz reference to the Transmitters and Receivers.
- 960 MHz added to signal output (on/off control)
- Microprocessor software can be downloaded remotely
- Fault isolation using Built-In Test (BIT) feature

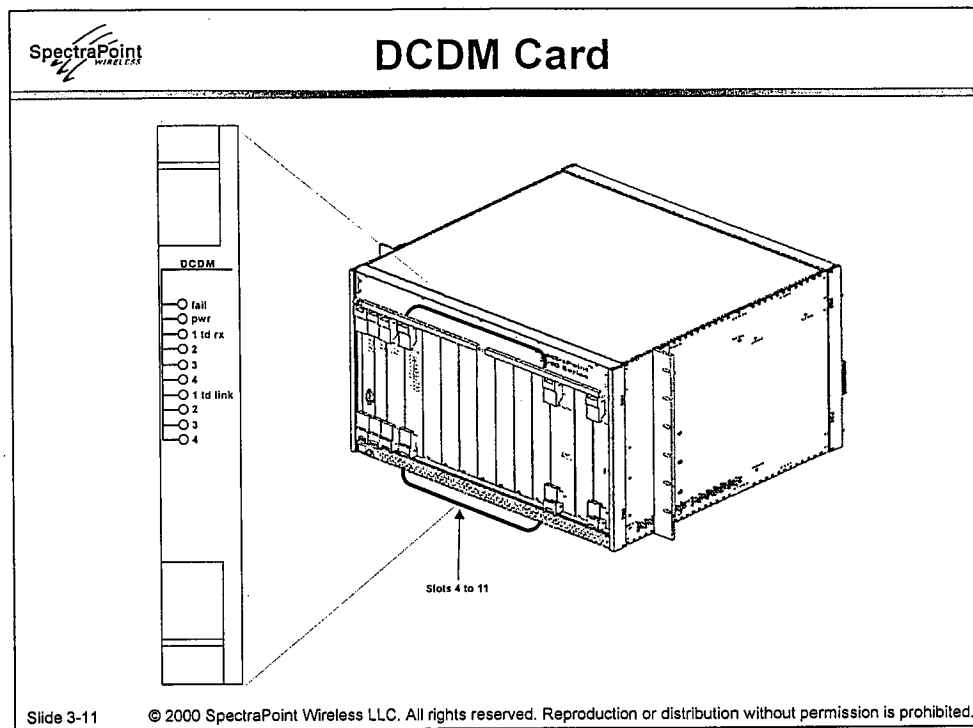
Attention: *This card can be hot swapped. However, it is non-redundant and provides common support for the Base Channel Group. Removal or replacement of this card will affect the entire Base Channel Group.*

High Speed Modulator (HSM) Card, continued

Card Status LEDs

The following card status LEDs are displayed on the front of the card:

- *fail* illuminates if a Built-in Test (BIT) fault is detected (red).
- *pwr* illuminates when DC voltage required by the card is present and good (green).



Downconverter/Demodulator (DCDM) Card

The Downconverter/Demodulator (DCDM) card is normally referred to as the **Quad DCDM** card, because there are four uplinks supported per card. Slide 3-11 shows a drawing of the Quad DCDM card

Standard BCG Configuration

One Quad DCDM card comes with the standard BCG configuration. The shelf has a capacity for seven more DCDM for a total of 8 DCDM cards per BCG shelf.

Functionality

- Receives CPE IF signal streams from the Node
- Downconverts the CPE signals from L-band to Baseband, and demodulates the ATM cell traffic
- Four independent CPE signal streams are multiplexed onto the UTOPIA bus
- Data interface with CCCP card for CPE control
- Processes link management commands
- Collects link level performance statistics
- Software is remotely downloadable
- Fault isolation using Built-In Test (BIT) feature

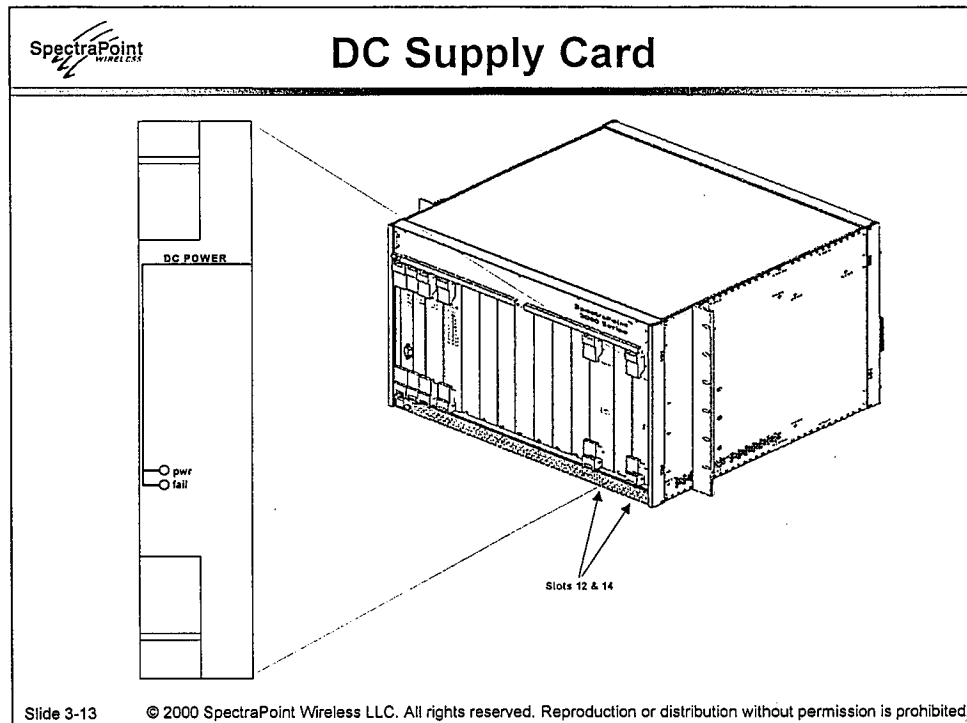
Downconverter/Demodulator (DCDM) Card, continued

Attention: *The Quad DCDM card can be hot swapped, and may be removed and inserted without disrupting the operation of any other DCDM card in the BCG.*

Card Status LEDs

The following LEDs and card status indicators are displayed on the front of the card:

- *fail* illuminates if a Built-in Test (BIT) fault is detected (red).
- *pwr* illuminates when DC voltage required by the card is present and good (green).
- *1 td rx/2/3/4* (N tuner demodulator receive) flash when the tuner demodulator for each link is receiving/processing cells (green).
- *1 td link/2/3/4* (N tuner demodulator link) indicate when the link associated with each demodulator is active, and solid illumination shows active connection (green).



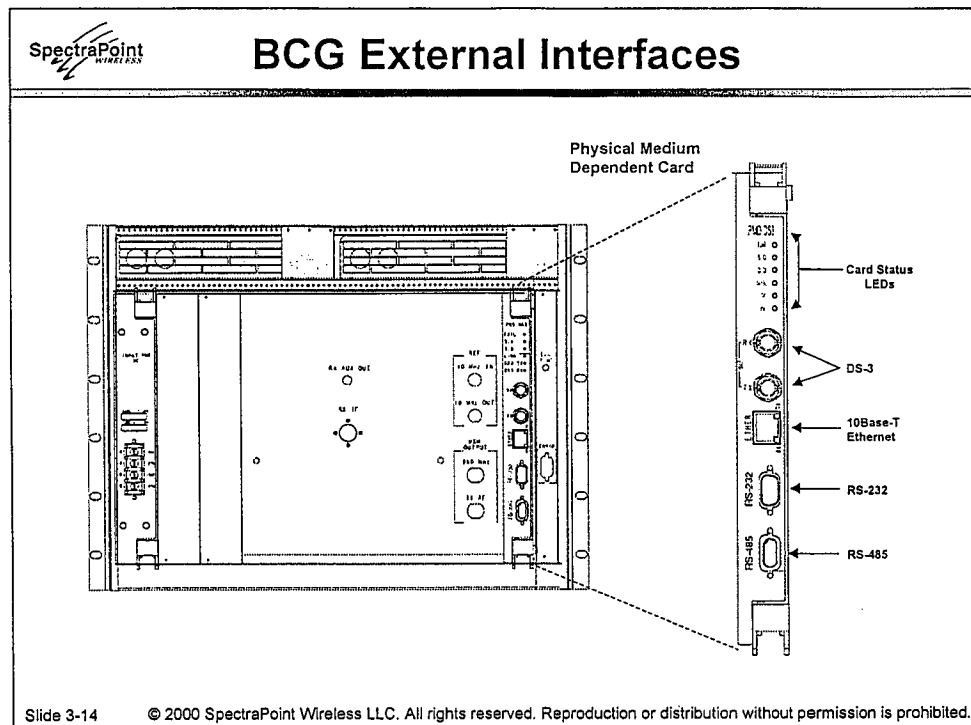
DC Supply Card

The BCG comes standard with two load-sharing DC Supply cards (-48 V DC); in the event of a failure in one supply, the remaining unit provides all power required by the BCG until the failed unit is replaced. A drawing of the Power Supply card is shown in slide 3-13. **Attention:** *This card may be hot swapped, and removal or replacement of a failed Power Supply card does not affect the operation of the BCG.*

Card Status LEDs

The following LEDs and card status indicators are displayed on the front of the card:

- *pwr* OK illuminates when -48 V DC required by the card is present and good (green)
- *fault* indicates card failure (red)



Base Channel Group Interfaces

Interfaces to the BCG are made using a Physical Medium Dependent (PMD) card and three connector panels at the rear of the BCG. The PMD card is shown in slide 3-14, and the PMD card is detailed on this page and on page 3-15. The connector panels are described on pages 3-16 and 3-17.

Physical Medium Dependent (PMD) Card

Connection to the ATM switch is made through the PMD card mounted behind the backplane. The PMD provides the connectors for the ATM switch interfaces, conditions the data stream for use by the Channel Controller/Cell Processor (CCCP) card, and provides other interfaces to the BCG. The PMD is discussed further on the next page, and PMD signal characteristics are detailed in the SP2200 Base Channel Group equipment manual.

PMD Connection Ports

- **ATM Payload signals**

DS-3c signals to/from an ATM switch connect through coaxial cable into two BNC connectors labeled TX and RX. Release 1 of the BCG supports DS-3 links only.

Note: *The DS-3c connection determines the ATM switch interface only; it does not determine the type of ATM switch it can connect to, or the types of traffic it can carry.*

- **10Base-T Ethernet Port**

The Base Channel Group provides an RJ-45 Ethernet connector labeled ETHER in the PMD card. The Ethernet connector is configured as a Transceiver port.

- **RS-232 Connections**

An RS-232 port for connecting the CID to the BCG is included. (Another RS-232 port is included on the front of the CCCP card as mentioned earlier.)

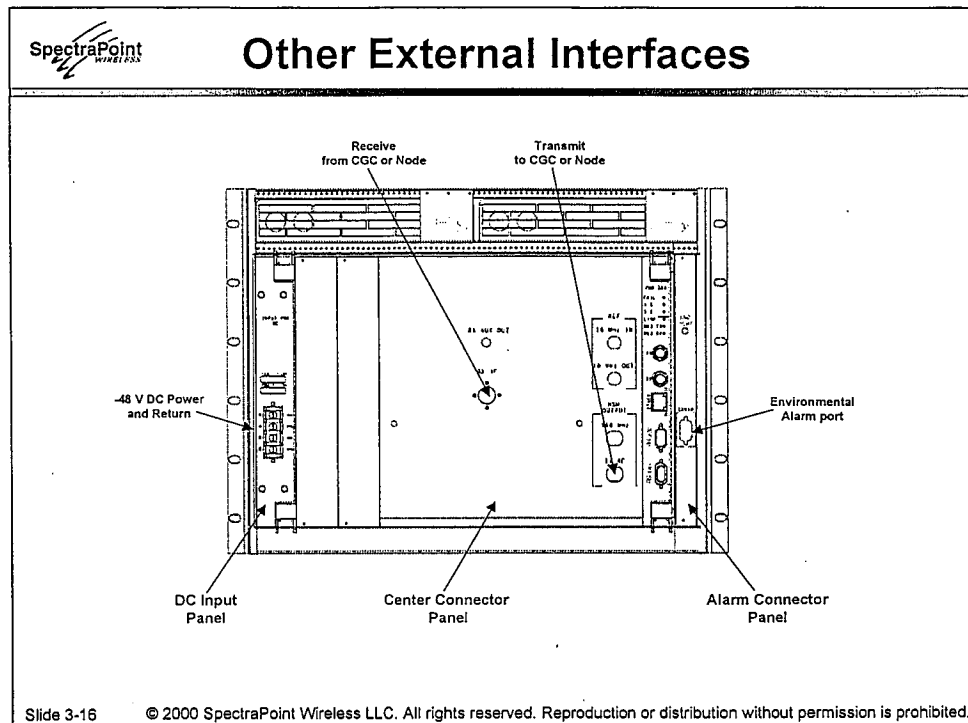
- **RS-485 Node Control Interface**

A DB-9 port is included for cabled connection from the Primary BCG to the Node.

Card Status LEDs

The following card status LEDs are displayed on the front of the card:

- *fail* illuminates if a Built-in Test (BIT) fault is detected (red).
- *5.0* illuminates when the DC voltage required by card is present and good (green).
- *3.3* illuminates when the DC voltage required by card is present and good (green).
- *link* illuminates when the DS-3 link from the ATM switch is in synch with the PMD card (green).
- *tx* illuminates when ATM cells are transmitted from the BCG to the ATM switch (green).
- *rx* illuminates when ATM cells from the ATM switch are being received (green).



Other External Interfaces

The remaining connections to the BCG are made using three connector panels as shown in slide 3-16:

- DC Input Panel
- Center Connector Panel
- Alarm Connector Panel

DC Input Panel

The -48 V DC power lines connect through a two-lug terminal strip on the DC input panel at the rear of the BCG. These terminals are designated as A and B. Connections from the panel to each Power Supply card is made internally, and power required by the BCG cards is distributed through the backplane.

Other External Interfaces, continued

Center Connector Panel

The Center Connector Panel provides the following connectors:

- **TX IF Connector (L-Band Transmit)**

The L-band Transmit cable to the Channel Group Combiner (CGC) or Node connects to the "TX IF" connector.

- **RX IF Connector (L-Band Receive)**

The L-band Receive cable from the CGC or Node connects to the "RX IF" connector.

- **Other Connectors**

- "RX AUX" is a RX IF test port.
- "10 MHz IN" is a input connector for an external 10 MHz reference to be used as an alternate for BCG timing. The preferred reference for the BCG is free run (10-MHz generated by the internal clock on the FRO card).
- "10 MHz OUT" provides a 10 MHz output from the BCG.
- "HSM Output 960 MHz" is a test port for the 960 MHz reference tone produced by the HSM card.

Alarm Connector Panel

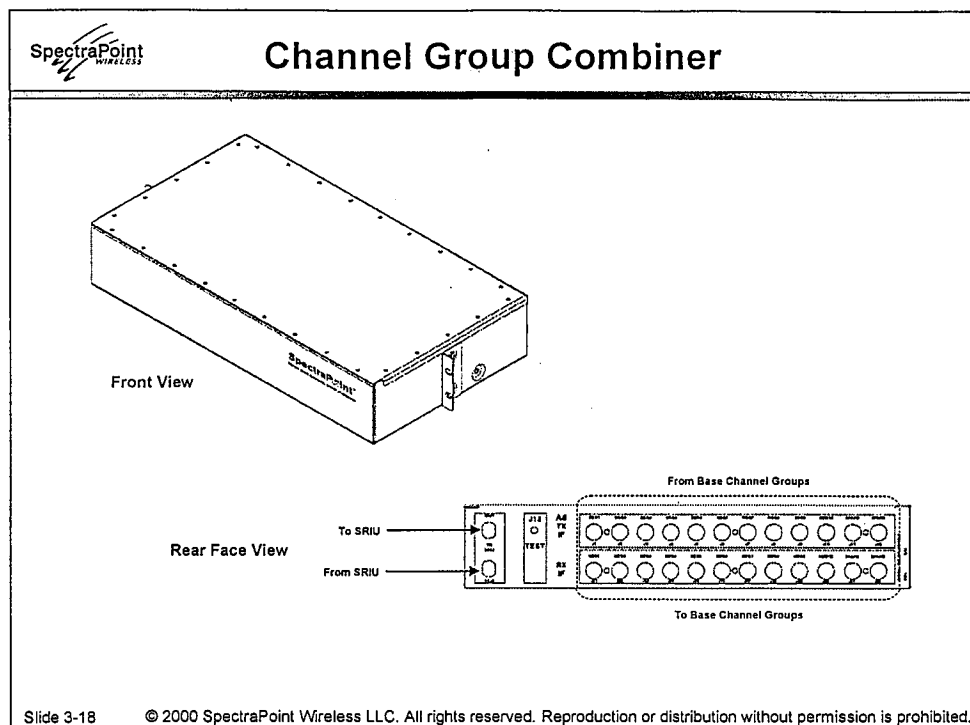
The alarm Connector Panel is located to the right of the PMD at the rear of the BCG. It provides the following connectors:

- **Environmental Alarms**

This connector is labeled ENVIR, and provides connections for environmental alarm sensors. Its use is optional, based on customer needs.

- **ESD Port**

An ESD port is provided for connecting an ESD wrist strap when working on the BCG.

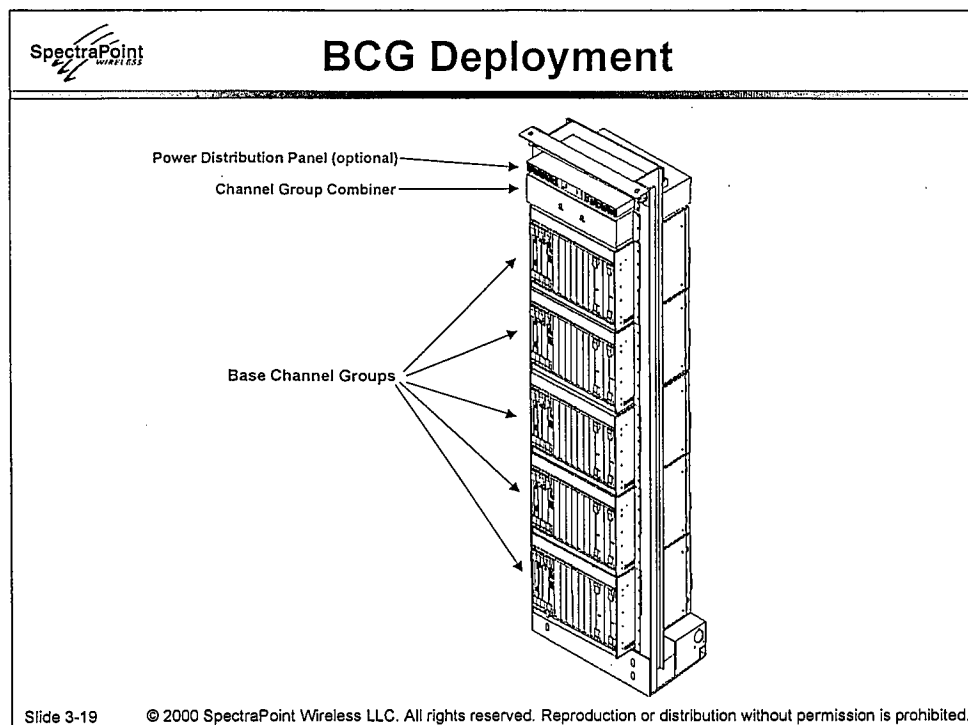


Channel Group Combiner

Slide 3-18 shows front and rear drawings of a Channel Group Combiner. This unit provides upstream and downstream interfaces to and from the BCGs to the SRIU and minimizes the number of cables carrying payload information from the Base to the Node to two - one for TX and one for RX.

Functionality

- One CGC required per sector, normally mounted in a 48 cm/19 in rack
- Concentrates IF signals between Base and Node
- Typically installed below the PDP, but may be remotely installed
- Needs 2U (9 cm/3.5 in) vertical space



BCG Deployment

Slide 3-19 shows one possible method of installing a Base Channel Group (BCG) in a 48 cm/19 in rack. This is an optional 2.1 m/7 ft rack with 5 BCGs installed, plus a Channel Group Combiner (CGC) and an optional Power Distribution Panel (PDP). Using this method, a fully deployed sector could have up to 10 BCGs (9 active and 1 redundant) in two racks, with 5 BCGs in the primary rack and 5 BCGs in the second rack. The CGC would be in the primary rack, and each rack could have a PDP.

One BCG in each sector is designated the Primary BCG, and serves the following dedicated functions:

- Furnishes the 960 MHz reference to the sector.
- Provides RS-485 and RS-232 communications for the sector, and functions as control for the sector.
- All configurations for the sector are created through the Primary BCG, except Virtual Channels (VC), Uplinks, and CPE services; these configurations are created at the individual BCG affected



Review Questions

- (1) The BCG comes standard with how many DC Supply cards (-48 V DC)?
- (2) What card provides the network interface to the BCG?
- (3) DCDM is the acronym for what card?
- (4) The FRO card provides a ____ MHz reference signal to the BCG.
- (5) Can the DCDM card be hot swapped?

Slide 3-20

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Review Questions

See slide 3-20 for end-of-section review questions.



Node Description

Upon completion of this section, the student will be able to discuss the following key features of the SP2200 Node:

- Sector Radio Interface Unit (SRIU)
 - Function of SRIU
 - Bulkhead connection panel
 - Plug-in Cards
 - Power Box
- Sector Mounting Frame
- Transmitters and Receivers
- Broadcast frequencies

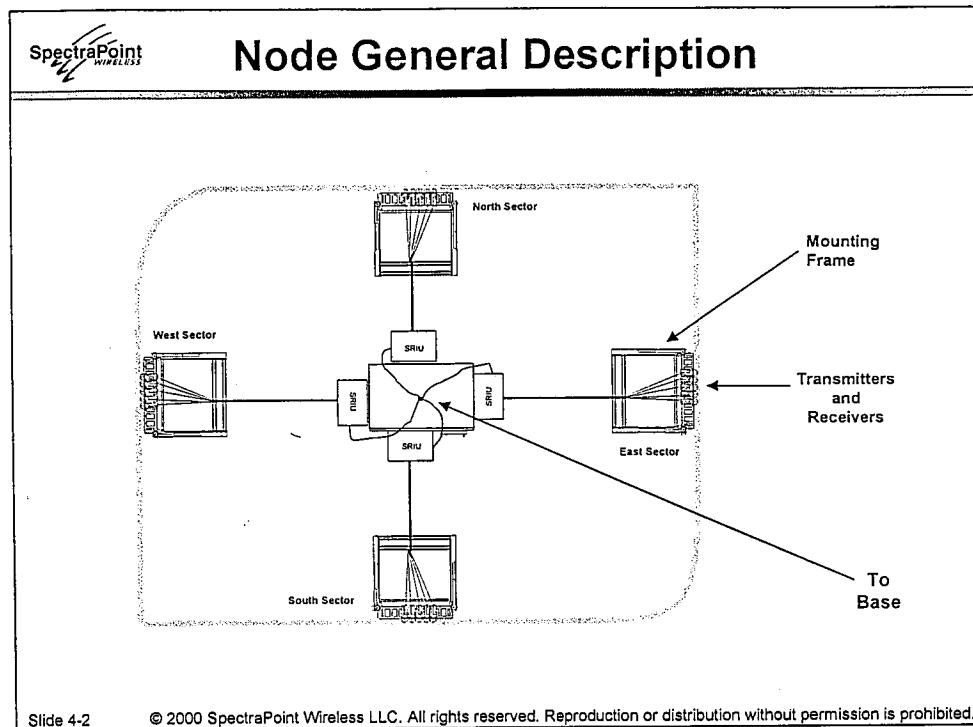
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Node Description

This section describes the components, functions, and applications of the **SpectraPoint™** SP2200 Node. See slide 4-1 for section objectives.

General

The Node receives IF signals from the Base, perform upconversion to 28 GHz, and transmits the outbound traffic to the Customer Premises Equipment (CPE). It also receives the in-bound 28 GHz signals from the CPE and downconverts these signals to IF and transports them to the Base. The Node covers up to a 5 kilometer radius, is divided into 90° sectors, and may contain up to four sectors. Each sector includes a mounting frame with transmitters and receivers, and a Sector Radio Interface Unit (SRIU) to distribute 28 GHz transmissions, control signals, and power.

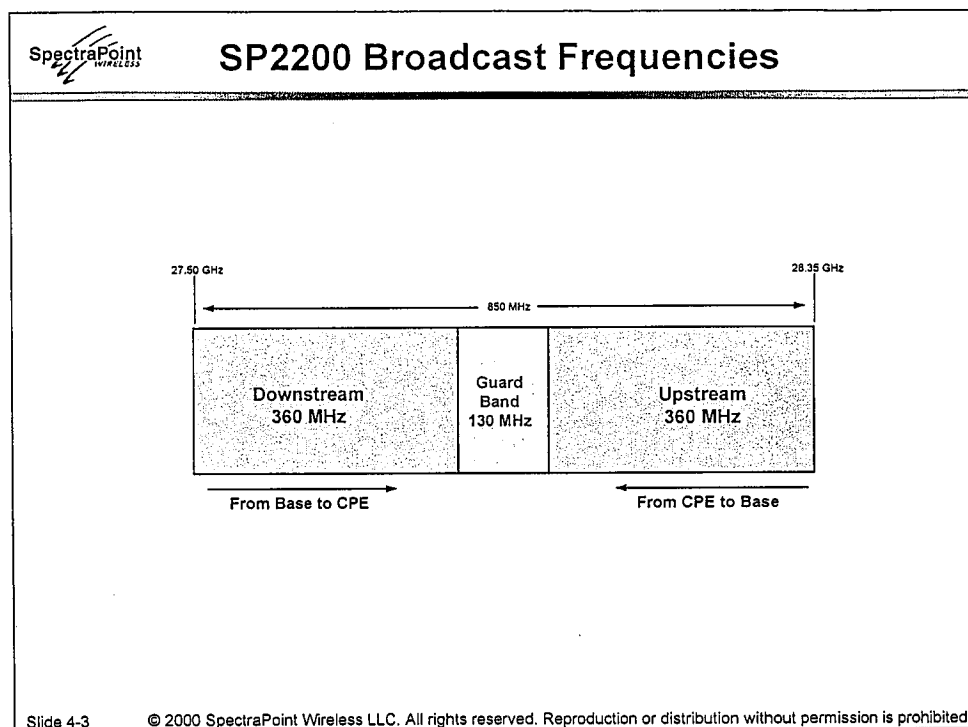


Node General Description

A drawing of a four sector Node is shown in slide 4-2.

Key Features

- Nodes broadcast Base signals up to a maximum of 5.0 km.
- Nodes are divided into four sectors positioned at 90° degree azimuths.
- Sectors are labeled North, South, East, and West as a means of differentiation, regardless of exact compass direction.
- Each sector has
 - One Sector Radio Interface Unit (SRIU)
 - Mounting frame for the Transmitters and Receivers
 - Transmitters and Receivers
 - Redundancy options available for TXs and RXs
- The Node equipment converts the Base L-Band output (950 MHz - 1950 MHz) to Ka Band (27.50 GHz - 28.35 GHz) for LMDS transmission between the Base Station and the Customer Premises Equipment (CPE) in both upstream and downstream directions.



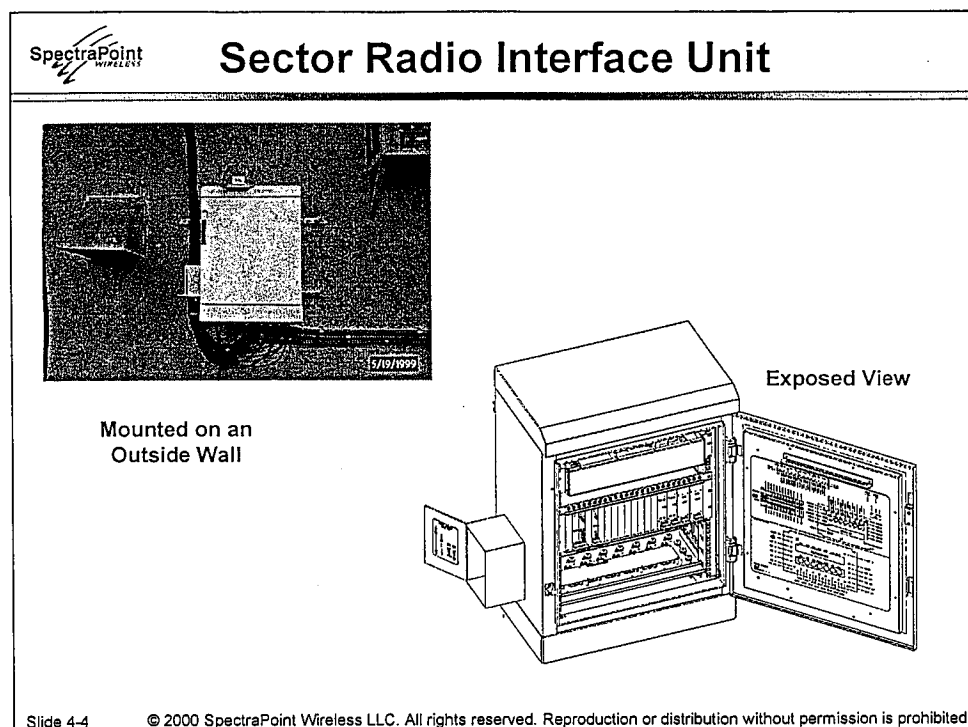
SP2200 Broadcast Frequencies

The SP2200 Node broadcasts the combined IF signals at the appropriate frequency for the host country; as of the date of this manual, the 2200 broadcasts at 28 GHz only. An example bandplan for 28 GHz (27.50 – 28.35 GHz) is shown in slide 4-3.

The SP2200 LMDS spectrum per 90° sector is subdivided as follows:

- 360 MHz used for Downstream (Base to CPE)
- 360 MHz used for Upstream (CPE to Base)
- 130 MHz used for guard band (or in-band Point-to-Point radio)

Note: For exact Node and sector specifications, see the *SP2000 Series Node equipment manual*.



Sector Radio Interface Unit (SRIU)

Slide 4-4 shows an SRIU mounted on an outside wall surface and an exposed view of the SRIU open for inspection.

General Description

The SRIU is a weather-tight electronics cabinet that provides signal distribution between the Base Channel Groups (BCGs) and the Node Radios (Transmitters and Receivers). Two coaxial cables carry upstream and downstream L-Band Intermediate Frequency (IF) signals between the SRIU and the BCG. If multiple BCGs are used for the sector, the L-Band signals are routed through a Channel Group Combiner (CGC).

Key Functions

- In the Downstream direction, the SRIU distributes the L-Band signals ("payload") from the Base to the sector Transmitters. In the Upstream direction, the L-Band signals from the Receiver are transported to the Base.

Key Functions, continued

- Provides RS-485 connectivity from the Base to the Transmitters and Receivers. The RS-485 signal is provided on a separate 4-wire 120 Ω cable from the Base to the SRIU. One pair is used for 2-way transmission and one pair for one-way bus reset control.
- Supports TX and RX redundancy in a sector, with minimal disruption during switchover to the redundant unit.
- Provides expansion of a sector by adding a Transmitter(TX) or Receiver (RX) without interrupting service to the other units. It allows hot insertion of a TX or RX.

SRIU Connections

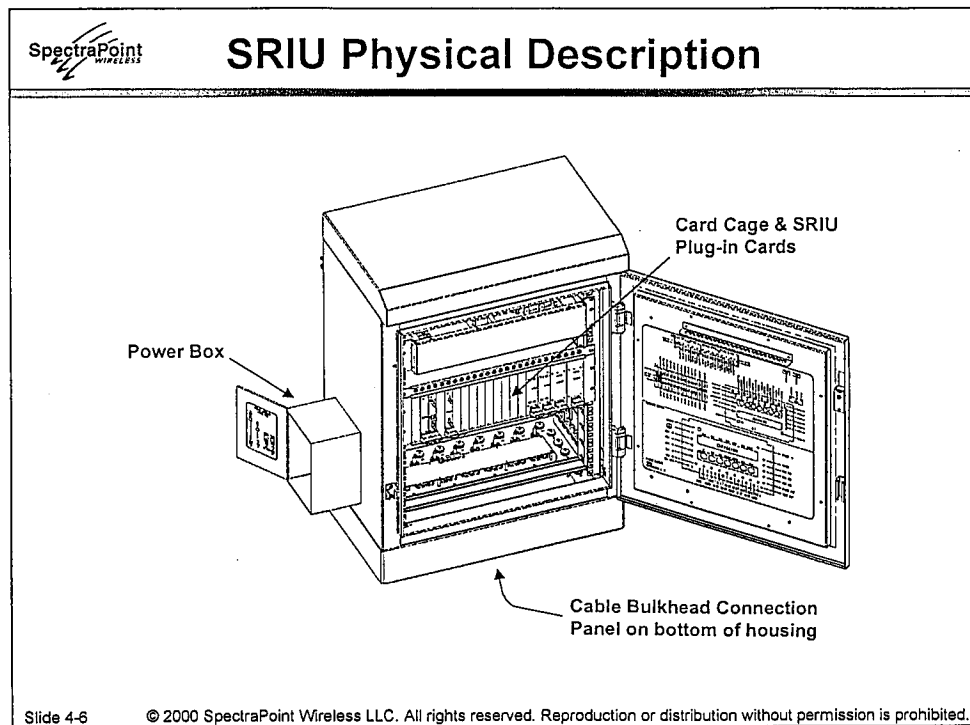
Four cables are used between the Base and the SRIU:

- IF Transmit cable (Downstream payload)
- IF Receive cable (Upstream payload)
- RS-485 control cable
- -48 V DC power cables

Three cables are used between an SRIU and each TX or RX:

- IF cable for TX (downstream payload) and RX (upstream payload)
- Local Oscillator (LO) Reference cable
- RS-485/-48 V DC power cable provides electronics power and heater power

Note: *A full description of the SRIU is contained in the SP2000 Series SRIU equipment manual.*



SRIU Physical Description

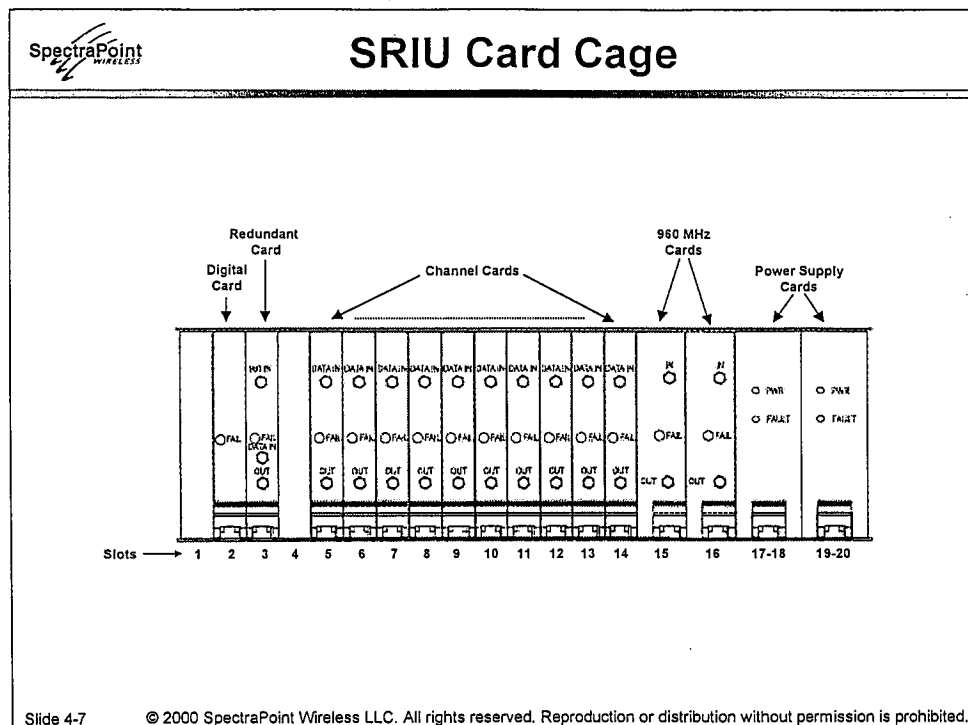
Size & Dimensions

- Dimensions (W x H x D) 61 cm x 81.3 cm x 38.1 cm
24 in x 32 in x 15 in
- Weight fully loaded 36.4 kg/80 lb

Cabinet Assembly

The Cabinet assembly consists of the following items:

- An **outdoor enclosure** with all associated wiring
- A **front door** allowing full access to the inside when opened; when closed it may be locked. A connection diagram is on the inside of the door.
- A 48 cm/19 in **Card Cage** to support the SRIU Plug-in Cards. The Backplane assembly is mounted on the back of the Card Cage.
- A **Bulkhead Connection Panel** provides terminations for the coax connections to the Transmitters and Receivers.
- A **Power Box** provides the -48 V DC input point.



SRIU Card Cage

The SRIU Card Cage shown in slide 4-7 has all the Plug-in cards required for a fully deployed sector. The backplane and Plug-in cards are detailed below and on the following page.

Backplane Assembly

The Backplane assembly is mounted on the back of the Card Cage and provides interface for the SRIU plug-in cards. It also supports power, fault detection, and RS-485 Control signals between the components plugged in the backplane and the Base.

SRIU Plug-In Cards

The plug-in cards are installed in the card cage as shown in slide 4-7:

- Slot 2 Digital card
- Slot 3 Redundant card
- Slots 5 - 14 Channel cards
- Slots 15 & 16 960 MHz cards
- Slots 17-18, 19-20 Power Supply cards

Note: (1) Slot 1 is unused; (2) Slot 4 is reserved for future use; (3) Blank plates fill slots 1 and 4; and, (4) The Power Supply cards require double slots for installation.

SRIU Plug-in Cards, continued

Power Supply Card

- Two Power Supply cards are used in the SRIU.
- These cards are redundant and load-sharing, and convert the incoming -48 V DC to the voltages required by the Node components and the TX/RX units.

Digital Card

- One Digital card is used in the SRIU.
- This card provides RS-485 interface for the SRIU, as well as the Transmitters and Receivers. RS-485 signaling is used for provisioning and control.

Channel Card

- The SRIU supports up to nine active (9) Channel cards, and one redundant Channel card.
- The 12-way Power Divider (splitter) in the Combiner/Splitter Tray splits the incoming IF (payload) signals from the CGC, and distributes the signal to each Channel card.
- Each Channel card then preselects (filters) and amplifies a unique, single 40/80/120-MHz channel for each Transmitter in the sector. No two Channel cards are identical in a given sector - each one contains a preselected 40/80/120-MHz filter.
- The output of a Channel card is the input to the IF port of a Transmitter.

Redundant Card

- Supports Transmitter and Receiver redundancy.
- This card is identical to the Channel card except that it contains a filter for each channel, and allows selection of any one of the filters for redundant operation. It also allows for redundant operation of the Pilot Tone Transmitter when one is required.

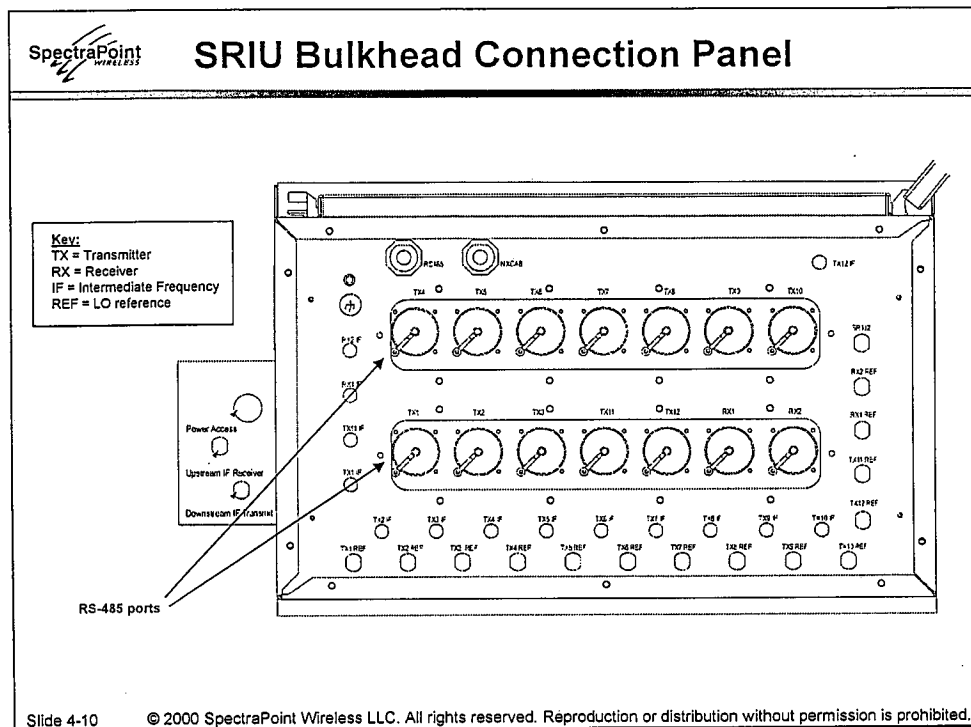
SRIU Plug-in Cards, continued

960 MHz Card

- The SRIU uses two 960 MHz cards in the Card Cage.
- The reference signals from the Combiner/Splitter Tray are amplified on individual 960 MHz cards.
- The use of two parallel 960 MHz cards provides redundancy for the reference signal. In the event of a card failure, the output power will drop by only 6 dB.
- The output of each 960 MHz card is sent back to the Combiner/Splitter Tray for distribution to the TXs and RXs.

Card Status LEDs

- All Plug-in cards have a card status *FAIL* LED on the card front:
 - This LED is normally illuminated green.
 - In the event of a card failure, the LED turns red.
- The Power Supply card has two LEDs:
 - A *PWR* LED illuminates when power is active on the card (green).
 - Card fault indication is shown by a *FAULT* LED that turns red when a card fault occurs.

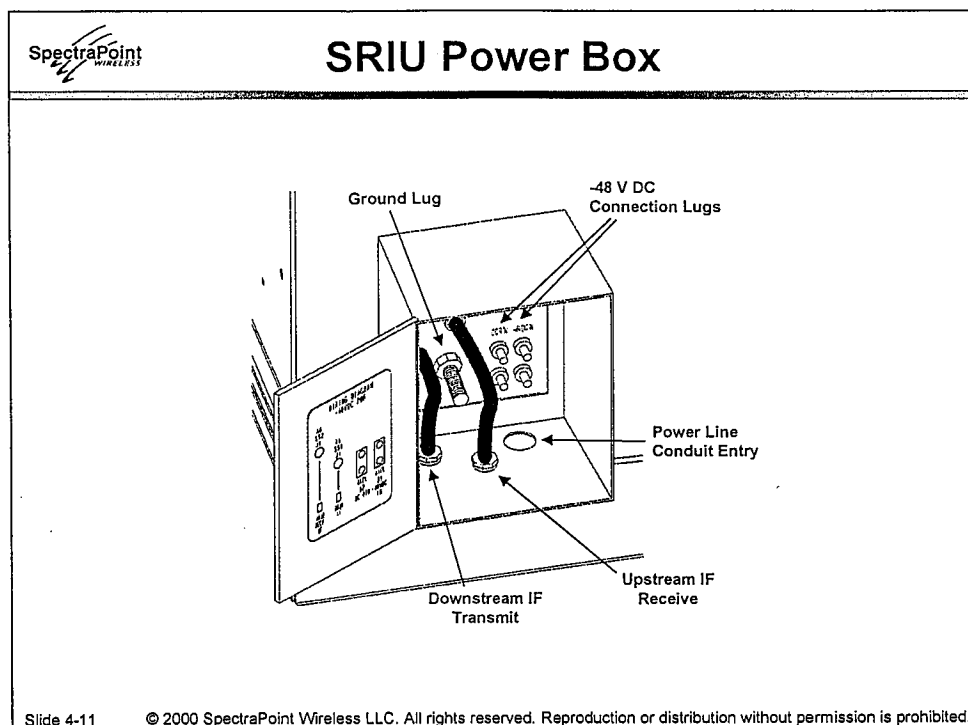


SRIU Bulkhead Connection Panel

The SRIU Bulkhead Connection Panel includes the I/O assemblies and is located on the bottom of the SRIU cabinet. A drawing of the connection diagram on the door is shown in slide 4-10. On the left side of the SRIU is the Power Box which is detailed on page 4-11.

The connector panel provides 45 connectors.

- Forty-two of these provide connection to the Transmitters and Receivers. There are three cable ports for each Transmitter (TX) and Receiver (RX) as follows:
 - IF cable (Payload L-Band) downstream to the TX and upstream from the RX
 - LO signal cable provides 960 MHz reference
 - RS-485/power cable provides RS-485 control, electronics power, and Radome heater power. **Note:** *The Radome heater power can be switched off during the warmer months when icing is not a concern.*
- The remaining connectors are:
 - RS-485 that connects to the Base
 - NXCAB and SRIU2 reserved for future use



SRIU Power Box

A drawing of the SRIU Power Box is shown in slide 4-11. The Power Box connects the SRIU to a -48 V DC source and also connects the IF cables from the Base.

- **IF Transmit**

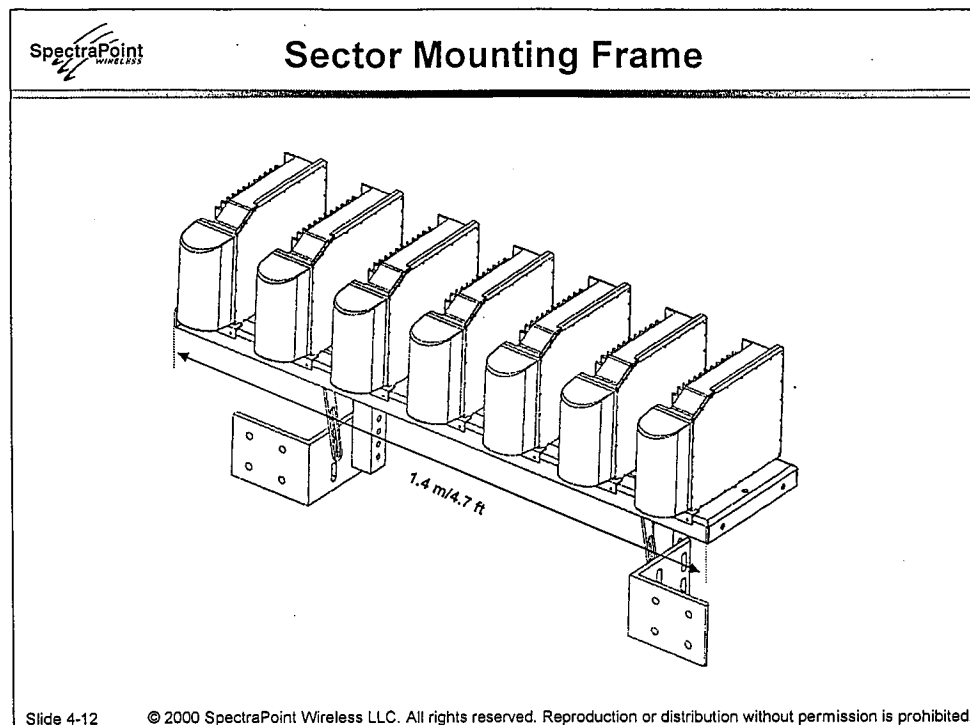
The IF Transmit cable carries Downstream payload to the Transmitters.

- **IF Receive**

The IF Receive cable carries Upstream payload from the Receiver.

- **-48 V DC power**

-48 V DC connections for the SRIU electronics and for power for the Transmitters and receivers.



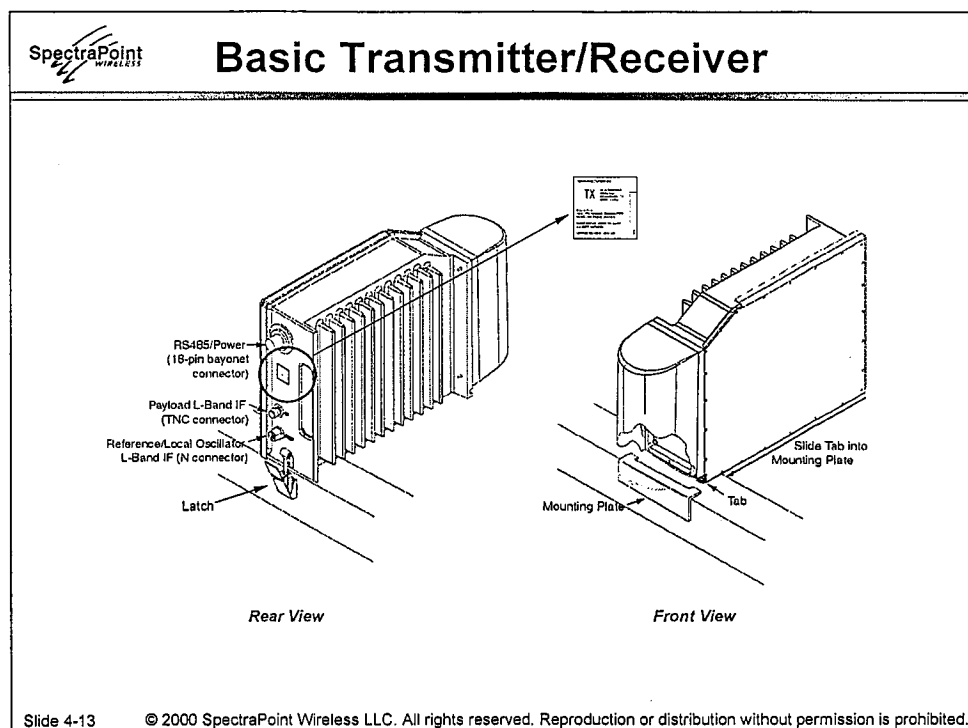
Sector Mounting Frame

Each fully equipped mounting frame carries the Transmitters and Receivers for the sector. The drawing in slide 4-12 is a ledge-mount sector radio (roof) mounting frame. The 7-radio mounting frame shown is one of many styles available; the style used depends on the customer deployment requirements.

The Transmitters (TXs) and Receivers (RXs) for each sector are connected to an SRIU. The Basic TX/RX is covered on pages 4-13 and 4-14, and the High Gain unit on pages 4-15 and 4-16.

Note:

- *Mounting centers will vary depending on mounting frame.*
- *The number of Transmitters and Receivers used depends on the customer deployment.*



Basic Transmitter/Receiver

Slide 4-13 shows the front and rear views of a Basic Transmitter/Receiver. Listed below are common characteristics; unique features of each unit are listed on the page 4-14.

Common features

- Supports a 40/80/120-MHz channel
- Azimuth: +/-45 degrees
- Elevation: +6 /-13 degrees
- 14 dBi nominal antenna gain
- Horizontal or vertical polarization models
- Identification label on rear
- RJ-485 bus for control & monitor
- -48 V DC primary power
- Radome covering antenna can be heated during inclement weather
- Top of housing has built-in handle for easy handling

Basic Transmitter/Receiver, continued

Also shown in slide 4-13 are connection points and mounting information. The circled area and label depicting the factory ID tag are indicated on the left in the slide.

Unit Specifications

Common to both Transmitter and Receiver

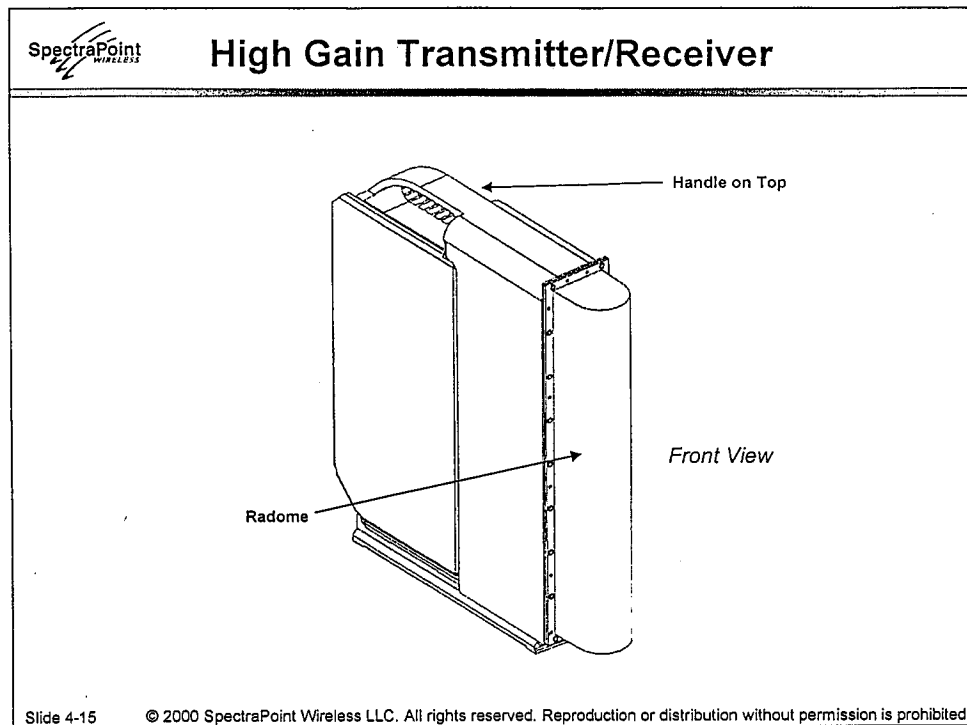
- Dimensions (W x H x D)
10 cm x 28 cm x 30 cm/4 in x 11 in x 12 in
- Weight: 9.1 kg/20 lb

Basic Transmitter (TX)

- IF input: 950 -1950 MHz
- Power output: 1 watt
- Frequency range: Ka Band of deployed country
- Power requirements
 - Electronics -48 V DC, 1.5 A
 - Radome -48 V DC, 1.0 A

Basic Receiver (RX)

- Frequency range: Ka Band of deployed country
- Noise floor: 7dB nominal
- IF output: 950 - 1950 MHz
- Power requirements
 - Electronics -48 V DC, 1.8 A
 - Radome -48 V DC, 1.0 A



High Gain Transmitter/Receiver

Slide 4-15 shows the front view of a High Gain (HG) Transmitter/Receiver. Listed below are common characteristics; unique features of each unit are listed on the next page.

Common Features

- Supports a 40/80/120-MHz channel
- Antenna bandwidth
 - Azimuth: ± 45 degrees
 - Elevation: $\pm 2/-30$ degrees
- 14 dBi nominal antenna gain
- Horizontal or vertical polarization models
- Identification label on rear
- RJ-485 bus for control & monitor
- -48 V DC primary power
- Radome covering antenna can be heated during inclement weather
- Top of housing has built-in handle for easy handling

High Gain Transmitter/Receiver, continued

The factory tag is on the rear in the same manner as the Basic unit, as described on page 4-14.

Unit Specifications

Common to both Transmitter and Receiver

- Dimensions (W x H x D)
13 cm x 43 cm x 48 cm/5 in x 17 in x 19 in
- Weight: 12.9 kg/28.5 lb
- High Gain Transmitter (HGTX)
- IF input: 950 -1950 MHz
- Power output: 1 watt
- Frequency range: Ka Band of deployed country
- Power requirements
 - Electronics -48 V DC, 1.5 A
 - Radome -48 V DC, 1.0 A

High Gain Receiver (HGRX)

- Frequency range: Ka Band of deployed country
- Noise floor: 7dB nominal
- IF output: 950 - 1950 MHz
- Power requirements
 - Electronics -48 V DC, 0.8 A
 - Radome -48 V DC, 1.0 A

Attention:

(1) *Basic TX/RX and High Gain TX/RX cannot be mounted on the same frame. Standard units mount at 1° below the horizon, and the High Gain units mount are mounted at 0°.*

(2) *Transmitters are hot swappable, and may removed or replaced without affecting any other unit in the sector.*

 Sector Loading with Pilot Tone	
<u>Minimum Redundant Loading</u>	<u>Maximum Redundant Loading</u>
1 - payload Transmitter 1 - redundant Transmitter 1 - Pilot Tone Transmitter	8 - payload Transmitters 1 - redundant Transmitter 1 - Pilot Tone Transmitter
1 - payload Receiver 1 - redundant Receiver	1 - payload Receiver 1 - redundant Receiver
<u>Total:</u> 3 TXs, 2 RXs	<u>Total:</u> 10 TXs, 2 RXs
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SP2200 Sector Loading with Pilot Tone

Slide 4-17 shows the minimum and maximum Sector Redundant Loading for Transmitters and Receivers for a 90° sector, using Pilot Tone and Roof Top Unit (RTU) Rel.1. Supporting redundant operation of Transmitters and Receivers requires that an SRIU be used in each sector.

A fully equipped SP2200 Node will support a maximum of 36 Transmitters (8 payload, 1 Pilot Tone) and 8 Receivers mounted on four sector mounting frames (9 TXs and 2 RXs per frame).

 Sector Loading without Pilot Tone	
<u>Minimum Redundant Loading</u>	<u>Maximum Redundant Loading</u>
1 - payload Transmitter 1 - redundant Transmitter	9 - payload Transmitters 1 - redundant Transmitter
1 - payload Receiver 1 - redundant Receiver	1 - payload Receiver 1 - redundant Receiver
<u>Total:</u> 2 TXs, 2 RXs	<u>Total:</u> 10 TXs, 2 RXs
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SP2200 Sector Loading without Pilot Tone

Slide 4-18 shows the minimum and maximum Sector Redundant Loading for Transmitters and Receivers for a 90° sector without Pilot Tone, using Roof Top Unit (RTU), Rel.2*. Supporting redundant operation of Transmitters and Receivers requires that an SRIU be used in each sector.

A fully equipped SP2200 Node will support a maximum of 36 payload Transmitters and 8 Receivers mounted on four sector mounting frames (9 TXs and 2 RXs per frame).

***Note:**

- (1) A Pilot Tone Transmitter is required per sector as of the date of this manual issue. It provides a 960 MHz tone for the RTUs (version 1.0).
- (2) RTU version 2.0 does not require a separate transmitter for Pilot Tone. Specific Pilot Tones will be utilize specific overhead in the sector Band Plan for this function.



Review Questions

- (1) Node has how many sectors?
- (2) Each sector has:
 - ☐ SRIU
 - ☐ Mounting frame
 - ☐ TXs & RXs
- (3) Are there redundancy options available for TX/RX?
- (4) Sectors are labeled North, East, South, and West. Are these exactly by compass direction?
- (5) The SRIU has one _____ for each Transmitter.
- (6) All connections from the SRIU to the TX/RX are made at the _____.

Slide 4-19

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Review Questions

See slide 4-19 for end-of-section review questions.



CPE General Description

Section Objective:

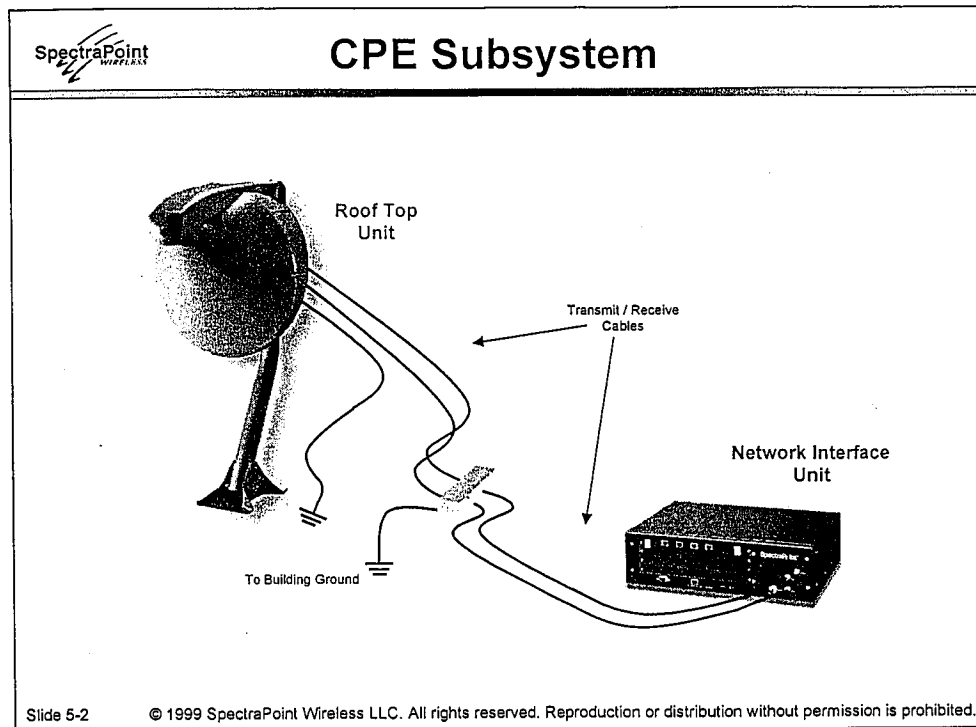
Upon completion of this section, the student will be able to recognize and discuss the following key features of the SP2200 CPE:

- **Rooftop Unit (RTU)**
 - Roof mounted transceiver dish antenna
 - Adjustable polarization
 - Adjustable mounting position
 - Power requirements
- **Network Interface Unit (NIU)**
 - SP2200 unit inside subscriber location
 - Interworking Function (IWF) cards support T-1/E-1
 - Built-in 10Base-T port
 - Remotely provisionable
 - 110 V or 220 V AC powered

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CPE General Description

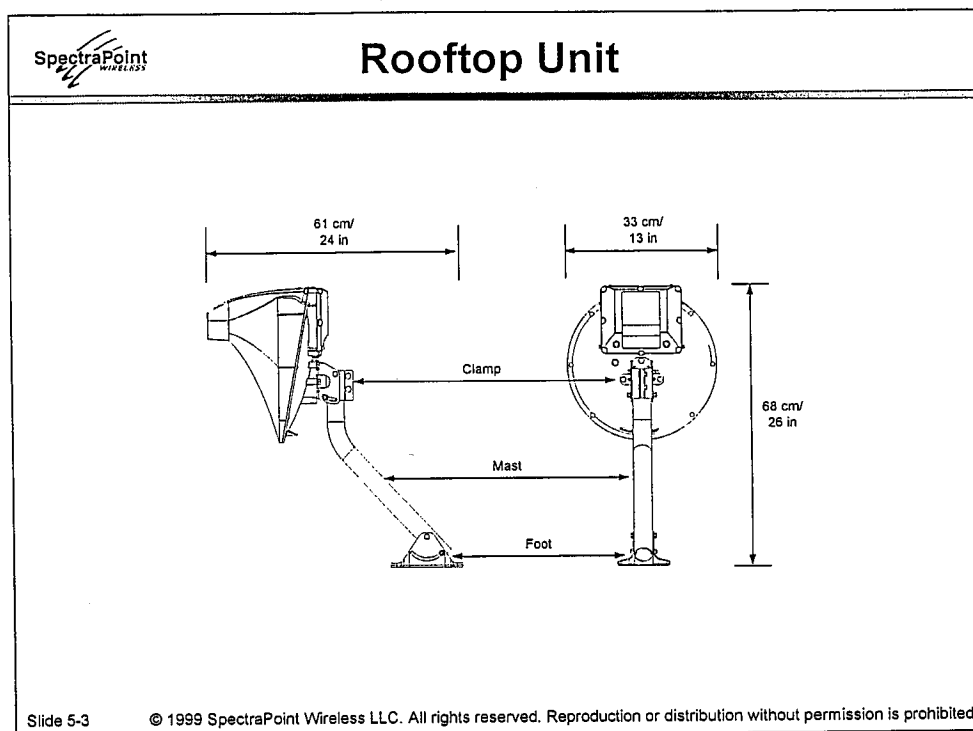
This section describes the **SpectraPoint™** SP2200 CPE, including the Rooftop Unit (RTU) and the Network Interface Unit (NIU). See slide 5-1 for section objectives.



The CPE Subsystem

The Customer Premises Equipment (CPE) subsystem, shown in slide 5-2, includes:

- Rooftop Unit (RTU), a transceiver antenna with built-in supporting electronics.
- Network Interface Unit (NIU), connecting to the subscriber's network.
 - The subscriber's voice and data equipment connects to ports on the InterWorking Function (IWF) cards in the NIU.
 - The subscriber's LAN connects to the built-in 10Base-T Ethernet port. **Note:** *This is a system option and is activated upon subscriber request.*
 - The distance limitation from the RTU to the NIU is 61 m/ 200 ft using RG-11 coaxial cables.
- All associated cables, plus the grounding block.

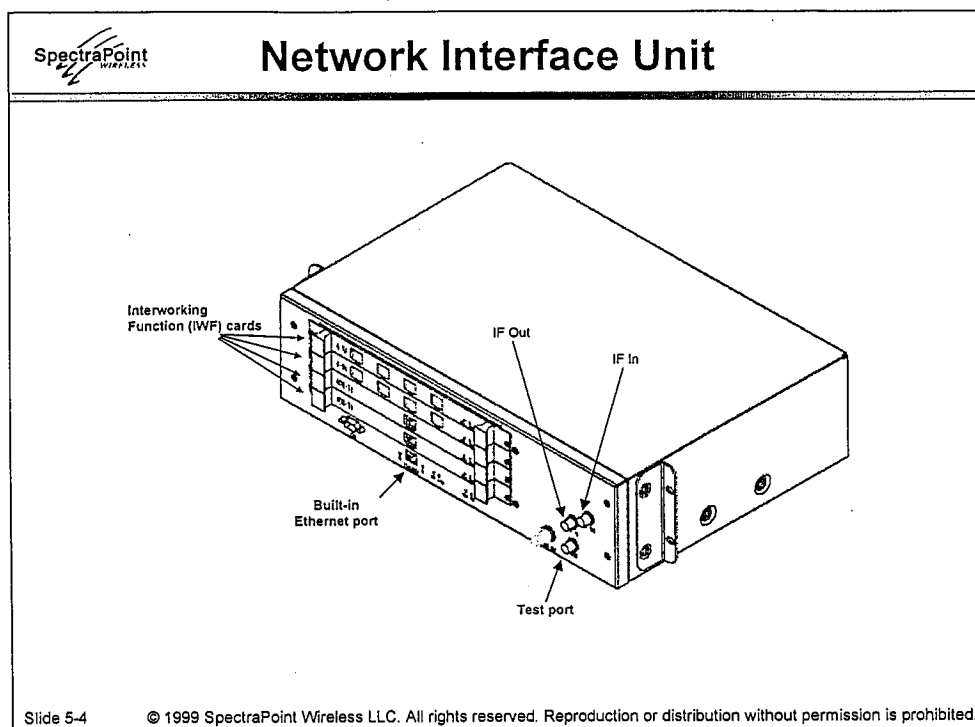


Rooftop Unit (RTU)

A drawing of the RTU is shown in slide 5-3. The Rooftop Unit consists of a 33 cm/13 in transceiver dish antenna with radome and built-in electronics. Because the LMDS radio signals require a clear Line of Sight (LoS) to the Node, the RTU typically mounts on a rooftop, tower, exterior wall or other elevated structure. The mount assembly can be adjusted to allow for vertical, horizontal or angled surfaces.

Specifications

- Interface between Node and NIU using dual coaxial cables
- Broadcasts applicable frequency for deployment,
 - example: 27.50 to 28.35 GHz for 28 GHz Bandplan
- L-band interface (950 MHz - 1950 MHz) to NIU
- 35 dB antenna gain
- 100 mW MMIC power amplifier
- Selectable polarization: horizontal or vertical
- Adjustable mounting mast
- Weight 3.6 kg/8 lb
- Power supplied by NIU over RX coax, may be +12 V DC or +24 V DC
- UL 1950 listed
- FCC certified



Network Interface Unit (NIU)

The Network Interface Unit (NIU), shown in slide 5-4, converts L-band signals from the RTU into the format required by the subscriber's network. The NIU may be rack-mounted or wall-mounted; the unit shown has universal brackets installed for rack mounting.

Features

- Internal components include modem and main ATM processor board
- Provides L-band interface to the RTU using dual coax
- Tunable Transmit and Receive IF
- Interworking Function (IWF) cards
 - Quad T-1/E-1 IWF provides T-1/E-1 Circuit Emulation Service (CES) for 4 circuits
 - Four IWF slots per NIU (3 CES maximum)
- May be remotely provisioned "Over the Air" (OTA) using Element Management System (EMS)
- Dimensions (WxHxD): 45.7 cm x 10.2 cm x 31.8 cm
18 in x 4 in x 12.5 in
- 110 V AC/60 Hz or 220 V AC/50Hz
- Weight 7 kg/15.5 Lb (fully loaded)

Network Interface Unit (NIU), continued

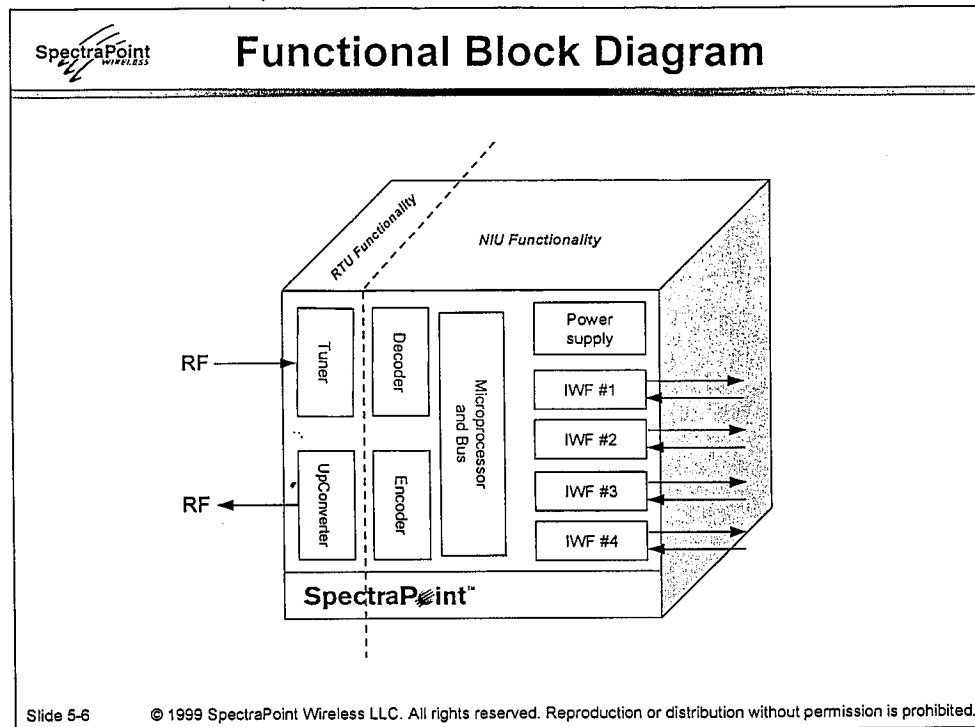
Interfaces

The NIU interfaces include:

- IWF cards with RJ-48 connectors for T-1/E-1 CES:
 - In T-1 or balanced E-1 applications, an 8-wire cable is used to connect to the subscriber's equipment (normally a channel bank, router or PBX).
 - For unbalanced E-1 applications, an 8-wire cable is connected to a Balun; the Balun provides two coaxial cables - one for TX and one for RX. These coaxial cables connect to the subscriber's equipment.
- A built-in 100-ohm 10Base-T Ethernet port with an RJ-45 connector. This port, when enabled, can provide up to 10 Mbps of IP data configured as an Ethernet bridge (IEEE 802.1d) or for Virtual LAN (VLAN - IEEE 802.1q). **Note:** *This is a system option and is software activated upon subscriber request (at time of deployment or at a later date); appropriate software licenses must be purchased.*
- Planned enhancements include
 - Cards for Frame Relay Access, HSSI, and Multi-function (8Xn) support
 - Software plug-ins for DS-0 grooming and CES/Frame Relay capability

Installation

- The NIU is installed indoors, typically in a utility closet near other rack- or wall-mounted telephone equipment. It is connected to the RTU with two coaxial cables (TX and RX), and must be located within 61 m/200 ft of the RTU to avoid signal degradation.
- Additional external equipment, such as a channel bank or a router, may be installed to meet subscriber voice and data applications.
- Detailed information on installation is contained in a separate training course.



CPE Functional Block Diagram

The CPE in block form with key functionality is shown in slide 5-6.

Rooftop Unit (RTU) Functional Description

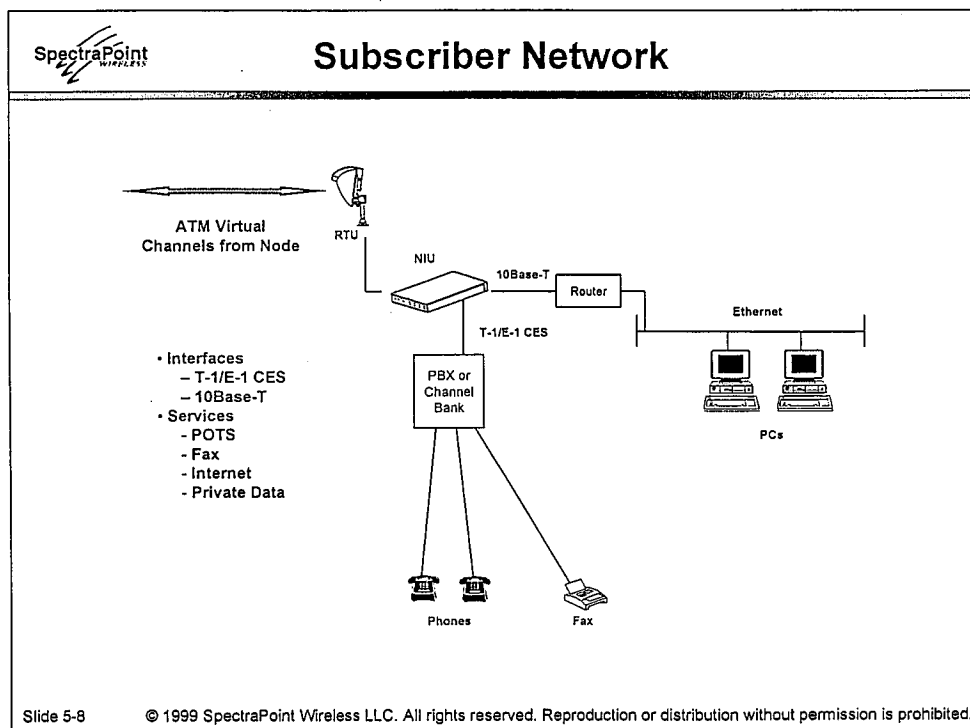
- In the downstream direction, the receiver in the RTU receives the Ka Band signal transmitted OTA from the Base Station and the Tuner downconverts this transmission to L-Band Intermediate Frequency (IF).
- In the upstream direction, the RTU transmitter upconverts the L-Band IF signal generated by the NIU Encoder to Ka Band and transmits the signal to the Base Station.

Network Interface Unit (NIU) Functional Description

- In the downstream direction, the Decoder decodes the IF signal produced by the RTU to produce the subscriber's LMDS channel and the Microprocessor performs data buffering and data modification on the channel signal from the Decoder

Network Interface Unit (NIU) Functional Description, continued

- The resulting signal is sent to the UTOPIA bus, which provides interfaces for the CPU (Level 1 bus) and interfaces to the IWF cards (Level 2 bus).
 - User interfaces are provided by the Interworking Function cards and by the built-in 10Base-T Ethernet port.
- In the upstream direction:
 - This may be thought of as the reverse of the downstream steps just covered.
 - The Encoder adds Reed-Solomon error encoding, modulates the signal, upconverts the signal to L-band IF, and sends the signal to the RTU.



Subscriber Network

Slide 5-8 shows a drawing of a typical subscriber network using T-1 or E-1 CES, plus 10Base-T provided by the SP2200 LMDS system.

The ATM virtual channels are received by the RTU and transported to the NIU in the subscriber's telephone closet. In this instance, the T-1/E-1 CES connects to a PBX or a channel bank for voice services (phones and fax), and the Ethernet (10Base-T) interface connects to a router for Internet access.



Review Questions

- (1) The acronym for the Rooftop Unit is ____.
- (2) It is placed where at the subscriber location?
- (3) The transmission received by the Rooftop Unit is from the ____.
- (4) NIU stands for ____.
- (5) The NIU may be rack-mounted only. True or False?
- (6) Interfaces to the NIU are provided by ____ cards.

Slide 5-9

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Review Questions

See slide 5-9 for end-of-section review questions.



Glossary

A

AAL - ATM Adaptation Level

AAL accomplishes conversion from the native data format and service specifications of the user data into the ATM layer.

- AAL-1 functions in support of traffic that is connection-oriented, Constant Bit Rate (CBR), and time-dependent such as uncompressed, digitized voice.
- AAL-5 functions in support of data traffic that is based on Variable Bit Rate (VBR) delay-tolerant connection-oriented information requiring minimal sequencing and/or error detection support.

AGC - Automatic Gain Control

A signal that varies with the average strength of the incoming radio signal. As the incoming signal strength drops, the AGC signal is used to increase the sensitivity of the receiver.

ALC - Automatic Level Control

A control system that automatically adjusts the incoming signal to a predetermined level.

Antenna gain

The measurement of the effective gain or area of an antenna relative to an omnidirectional antenna. The unit of measurement is dB. High gain results in a smaller area or a narrower transmitted beam.

ASIC - Application Specific Integrated Circuit

An integrated circuit that performs functions for a single application.

ATM - Asynchronous Transfer Mode

A very high-speed transmission technology offering high bandwidth, with low delay; it is a connection-oriented, packet-like switching and multiplexing technique. Usable capacity is segmented into 53-byte fixed-size cells, consisting of a 48-octet Payload and a 5-octet Header which identifies the Virtual path, Virtual Channel, payload type, and cell loss priority. It allocates bandwidth on demand, making it suitable for high-speed connection of data, voice, and video services.

AWG - American Wire Gauge

A standard for measuring the thickness of non-ferrous (non-iron and non-steel) cables. The higher the number, the thinner the wire. The thicker the wire, the more current it can carry.

B

Base

The interface to a public or private network. The Base encodes ATM cells from the ATM switch, modulates them on an Intermediate Frequency (IF), and transports them to the Node for "Over-the-Air" transmission. The Base receives signals at IF from the Node, decodes and demodulates the ATM cells, and transports the cells to the ATM switch. See *also* Intermediate Frequency (IF) and Node.

BCG - Base Channel Group

The building block of the SP2200 system. It includes all of the hardware and software needed to implement LMDS services.

BIT - Built-In Test

Self testing capabilities that are part of the SP2200 Base Channel Group (BCG). Provides the ability to isolate individual card failures in the Base Channel Group and failures of individual CPEs.

BW - Bandwidth

Bandwidth is the capacity of a communications channel.

- In telecommunications, it is measured as bits per second (bps):
 - kilobits per second (kbps) - a thousand bits per second
 - Megabits per second (Mbps) - a million bits per second
 - Gigabits per second (Gbps) - a trillion bits per second.
- In RF, it is the frequency measured in Hertz (cycles per second):
 - kiloHertz per second (kHz) - a thousand cycles per second
 - MegaHertz per second (MHz) - a million cycles per second
 - GigaHertz per second (GHz) - a trillion cycles per second.

C

CCCP - Channel Controller/Cell Processor

May be thought of as the "brains" of the Base Channel Group (BCG). The CCCP CPU is the main processor in the BCG, and performs the ATM cell switching on Virtual Path and Virtual Circuit Indicators (VPI/VCI) in the ATM cell header to multiple sources. In addition, it is the Level 2 UTOPIA bus master.

CEC - Canadian Electrical Code

The Canadian equivalent of the NEC in the United States. *See NEC.*

CES - Circuit Emulation Service

An ATM term. The ATM Forum specification that supports emulation of existing TDM circuits over ATM networks.

CGC - Channel Group Combiner

This unit provides upstream and downstream interfaces to and from the BCGs to the SRIU, and helps minimize the number of cables from the Base to the Node. In addition to the transmit and receiver payload (CPE traffic), it also provides RS-485 interface and -48 V DC power to the TXs and RXs.

CID - Craft Interface Device

A Pentium II or later generation laptop computer on a Windows® 98 or NT platform running SpectraPRO software. *See also SpectraPRO.*

CO - Central Office

The CO switch is the local telephone company office to which all local loops in a given area connect, and in which circuit switching occurs.

CPE - Customer Premises Equipment

Equipment that consists of a Rooftop Unit (RTU) and a Network Interface Unit (NIU), which houses Interworking Function (IWF) cards. The RTU receives the Ka-Band radio signals from the Node transmitter. The NIU provides the service interface at the customer's site. *See also Rooftop Unit (RTU), Network Interface Unit (NIU), and Interworking Function (IWF) cards.*

D

dB - Decibels

DCDM - Downconverter/Demodulator

Referred to as the Quad DCDM. Each Base Channel Group can support a maximum of 8 DCDM. Supports four independent uplinks from CPEs, providing data interface to the CCCP card, downconversion, demodulation and decoding of the signal stream, and collection of performance statistics.

DIN - German Institute for Standardization

Specifications issued under the control of the German government. Some are used on worldwide basis to specify such things as cable connectors, often called DIN connectors.

Downconverter

An integrated assembly of components required to convert high frequency signals to an intermediate frequency range (IF) for further processing. *Contrast with upconverter.*

DS-1 - Digital Signal 1st level

A 1.544 Mbps digital link.

DS-1 Termination Point

The physical circuitry terminating the input and output of a DS-1 signal.

DS-3

A 44.736 Mbps digital link.

DSP - Digital Signal Processor

A specialized digital microprocessor that performs calculations on digitized signals that were originally analog (such as voice) and then sends the results on. DSPs are used extensively in telecommunications for tasks such as echo cancellation, voice compression, and video processing.

DVM - Digital Voltmeter (Multimeter)

An instrument with a digital readout used for measuring in volts the difference in potential between different points of an electrical current. May also be used to measure current and resistance.

E

EIA - Electronics Industries Association

A trade organization of manufacturers which sets standards for use of its member companies, conducts educational programs, and lobbies for its members.

EMS - Element Management System

A system that allows a user to control Provisioning, Fault Management, Performance Management, and Security Management for SpectraPoint™ equipment. The EMS also provides an interface to a higher level Network Management System (NMS) to enable the SP2200 to be managed as part of a larger communications network.

ESD - Electrostatic Discharge

Ethernet

A type of Local Area Network (LAN) characterized by a 10 Mbps/100 Mbps baseband transmission over shielded coaxial cable (10Base-2), twisted pair (10/100Base-T), or fiber optic cable (10/100Base-F), and employing the Carrier Sense Multiple Access/Collision Detection (CSMA/CD) media access control mechanism.

F

FR - Frequency Reference

A frequency used as a reference point.

FRO- Frequency Reference Oscillator

The FRO card provides a 10 kHz reference tone to the Base Channel Group.

FRO- Frequency Reference Oscillator

The FRO card provides a 10 kHz reference tone to the Base Channel Group.

Frequency Reuse

The ability to use the same frequencies repeatedly within a single system, made possible by the basic design approach used in cellular communication. Since each cell is designed to use radio frequencies only within its boundaries, the same frequencies can be reused in cells not far away with little potential for interference.

G

Gbps - Gigabits

A measurement of bandwidth, a trillion bits per second.

GHz - GigaHertz

A measurement of frequency, a trillion cycles per second.

GUI - Graphical User Interface

Pronounced "GOO-ey". A generic name for any computer interface that substitutes graphics for characters.

H

HSM - High Speed Modulator

Each Base Channel Group has one HSM card. The HSM modulates and upconverts the downstream signals, supports the command link with the Cell Processor, and provides the 960 MHz reference for the BCG.

I

IEEE - Institute of Electrical and Electronics Engineers

IEEE 802.1d

This specification documents the algorithm that is used to prevent bridging loops by creating a spanning tree.

IEEE 802.1q

This specification documents the design specifications for a Virtual Local Area Network (VLAN).

IF - Intermediate Frequency

The SP2200 uses an intermediate frequency between 950 MHz and 1950 MHz. Incoming frequencies within the LMDS system are converted to IF for processing and distribution in SpectraPoint.

ILEC - Incumbent Local Exchange Carrier

A traditional Local Exchange Carrier (LEC) which was never part of the Bell System.

IP - Internet Protocol

ISP - Internet Service Provider

IWF - Interworking Function cards

Cards used in the Network Interface Unit (NIU) that provide the conversion between the SpectraPoint™ wireless ATM protocol and the necessary customer service protocols (for example, T-1/ E-1, ATM over T-1/E-1, etc.).

K

kbps - kilobits

A measurement of bandwidth, a thousand bits per second.

kHz - kiloHertz

A measurement of frequency, a thousand cycles per second.

L

LAN - Local Area Network

A short distance data communications network (typically within a building or campus) used to link together computers and peripheral devices (such as printers) under some form of local control.

LMDS - Local Multipoint Distribution Services

A radio-based system for distribution of voice, data, and video information. LMDS provides the "last mile" of the connection to the customer over the air, without using copper or fiber land lines.

LO - Local Oscillator

Equipment that generates a single frequency signal on a local basis.

LoS - Line of Sight

Any transmission media that operates at a frequency that transmits in a perfectly straight line requires a clear LoS. The area between the transmitter and the receiver must be clear of obstructions.

M

Managed Object

Logical entities "stored" in the Management Information Base (MIB) that represent the hardware and software resources in the Network Elements.

Mbps - Megabits

A measurement of bandwidth, a million bits per second.

MHz - MegaHertz

A measurement of frequency, a million cycles per second.

N

NEC - National Electrical Code

A nationally recognized safety standard for the design, construction, and maintenance of electrical circuits (U.S.). It also gives rules for the installation of electrical and telephone cabling.

NIU - Network Interface Unit

A part of the CPE that provides signal processing and service interface points for a variety of Asynchronous Transfer Mode (ATM) Interworking Function (IWF) cards. See *also* Customer Premises Equipment (CPE).

NMS - Network Management System

A comprehensive system of equipment and software used in monitoring, controlling, and managing a data communications network.

NOC - Network Operations Center

A group responsible for the day-to-day matters of administering network control. This includes monitoring, reconfiguration, trouble reporting, alarm tracking and clearing, as well as other functions needed for the card and feeding of a network.

Node

SpectraPoint™ equipment (Transmitters, Receivers, and associated electronics) that transmits and receives signals between the Base and Customer Premises Equipment (CPE). The Node communicates with the Base using Intermediate Frequency (IF) signals over copper and fiber, and communicates with the CPE using 28 GHz Radio Frequency (RF) signals over the air. See *also* Base, Intermediate Frequency, Radio Frequency, and Customer Premises Equipment.

NWN - New World Network

This term has been coined as a way of explaining the global realization that the quantity of data traffic over some service provider networks now exceeds or will soon exceed the total of all voice traffic.

O

OAM&P - Operations, Administration, Maintenance and Provisioning

Network management functions which provide network fault indication, performance monitoring, diagnostics and configuration capabilities.

OPEN NSÜ

The OPEN NSÜ is the NMS platform being used to implement the SpectraPoint™ Element Management System (EMS).

P

PBX - Private Branch Exchange

A digital or analog system located on the subscriber premises used to connect private telephone networks to the Public Telephone Switched Network (PSTN) and to provide internal switching of subscriber lines.

PCU - Power Conversion Unit

A unit used with the SP2200 to provide -48 V DC power needed by the System.

PDP - Power Distribution Panel

A optional unit installed at the top of each rack of Base Channel Groups (BCGs) to distribute the -48 V DC power from the PCU to each individual BCG and the Channel Group Combiner (CGC).

PMD - Physical Medium Dependent

An assembly used in the SP2200 Base Channel Group (BCG) that provides the interface connectors and drivers for terminating services into the BCG.

Provisioning

The programming of equipment devices and other resources with operational parameters for the purpose of initial setup or changing the configuration of the equipment.

PSTN - Public Switched Telephone Network

Generic term referring to the variety of telephone networks and services in place worldwide.

Q

QoS - Quality of Service

A measure of the service quality of RF links provided to a subscriber by the SP2200. Normally measured by link availability over time as a percentage, such as 99.99% (referred to as four 9's).

QPSK - Quaternary Phase Shift Keying

A compression technique used in modems and in wireless networks.

R

Radome

A plastic cover for a microwave antenna. It protects the antenna from bad weather and supports the vertical and horizontal polarity of the transmitted signal.

RF - Radio Frequency

Electromagnetic waves that are capable of being radiated through space (air). These range from a few kiloHertz (kHz) to several GigaHertz (GHz) up to the frequency of light. In LMDS typical RF is allotted in the 26 - 28 GHz range.

RFC - Request for Comment

An Internet Engineering Task Force (IETF) specification or standard.

RFC 1483

RFC defines two different techniques for encapsulating routed and/or bridged packets in ATM AAL-5 cells.

RS-232

An EIA standard data interface that connects serial devices. Currently, RS-232 generally refers to RS-232C.

RS-485

An EIA standard for multipoint communications.

RTU - Rooftop Unit

An integrated Radio Frequency (RF) transceiver that is part of the Customer Premises Equipment (CPE). *See also Customer Premises Equipment and Radio Frequency.*

RX - Receive or Receiver

S

SRIU - Sector Radio Interface Unit

SpectraPoint™ equipment used to concentrate signals from the Base to the Node.

SpectraPRO

The software residing on the Craft Interface Device. Used to configure, operate, and monitor the SP2200 system.

T

TCP - Transmission Control Protocol

Connection-oriented transport layer protocol that provides reliable full-duplex data transmission. TCP is part of the TCP/IP protocol stack.

TDM - Time Division Multiplexing

Technique in which information from multiple circuits can be allocated bandwidth on a digital link based on pre-assigned time slots. Bandwidth is assigned to each circuit regardless of whether the circuit is active or not.

TX - Transmit or Transmitter

U

Upconverter

A device for performing frequency translation in such a manner that the output frequencies are higher than the input frequencies. Contrast with *downconverter*.

UPS - Uninterruptible Power Supply

A device providing a steady source of electric energy to a piece of equipment.

UTOPIA - Universal Test and Operations Interface for ATM

Refers to an electrical interface between the Transmission Convergence (TC) and Physical Medium-Dependent (PMD) sub-layers of the Physical (PHY) layer, which is the bottom layer of the ATM Protocol Reference Model. UTOPIA is the interface for devices connecting to an ATM interface.

UTOPIA Bus

This is the bus used in the SP2200 to carry ATM traffic in the BCG backplane.

UTP - Unshielded Twisted Pair

A cable medium with one or more pairs of twisted insulated copper conductors bound in a single plastic sheath. This has become the most common method of bringing voice and data to the desktop.

V

VLAN - Virtual LAN

A group of devices on different physical LAN segments which can communicate with each other as if they were all on the same physical LAN segment.

W

WAN - Wide Area Network

A network that uses local service providers links that cover an extended/dispersed geographical area.

Sources

The sources for one or more definitions in this glossary are as follows:

- Desktop Encyclopedia of Telecommunications, 1998, Nathan J. Muller author
- Emerging Communications Technologies, 1997, Uyles Black author
- Newton's Telecom Dictionary, 1997, Harry Newton author
- *Wireless Industry Terms* website